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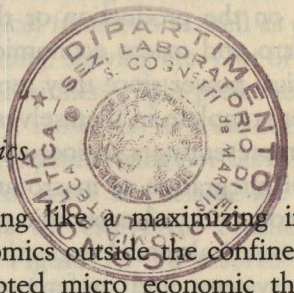
# ON RESOLUTION OF CONFLICTING PREFERENCES, ECONOMISTS' BLACK BOXES AND PARADIGMATIC MYOPIA

by
OLEG ZINAM *



## *Black Boxes in Conventional Economics*

The assumption of a firm acting like a maximizing individual has placed the field of micro-micro economics outside the confines of orthodox economic paradigm. Since the accepted micro economic theory assumes away a firm's organizational and power structures as well as the intrafirm behavior of its members, it really deserves the name of macro-micro theory. The micro-micro part is thereby placed into a conceptual "black box", analogous to the one in the "stimulus-response" approach by behaviorist psychologists as well as the one in Samuelson's "revealed preference" doctrine. These generalizations are also applicable to the behavior of a household.

The microeconomic "black box" conceals the intra-unit decision-making mechanism by assuming away the process of interaction among decision makers. Analogously, the macroeconomic "black box" neglects the complex interaction among firms, industries, management and labor organizations by postulating a competitive order and using the general equilibrium model. This method ignores the complexity of the organizational and power structures of the socioeconomic system within which the resolution of conflicting preferences takes place. The macro "black box" ignores the missing link between micro and macro economics, an area of study which could be called "micro-macro" theory.

The central question of micro-macro economics, forced by conventional economics into a "black box", is whose preferences in an economic system are rendered effective and to what extent. The manner in which the conflicts among preferences of consumers, producers, government, labor un-

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ions, management organizations and others are resolved depends on the degree of centralization of political and economic power within the socio-political system. In a predominantly market economy, the outcome of the interaction of the preference and opportunity functions of consumers, producers and government depends greatly on the organizational structures of the economic system which are influenced by the size and number of firms, character of the products, conditions of entry, and so on. Government uses its political power to establish and change, if necessary, the rules of the game in the market. It can be prompted to do so by various organized groups either on the production or the consumption side.

Both micro and macro economics, in their present state, are tools of limited analytical power since they represent only fractions of socioeconomic reality, neither complete in themselves nor adequately integrated in a meaningful model representing a socioeconomic system. One of the major reasons for the lack of integration of macro and micro economics is the too narrow scope of the conventional economic paradigm. It is not an exaggeration to state that a theoretical model neglecting strategic variables like organization, power, value systems and preferences, can neither be very relevant nor useful in the area of economic dynamics. Theories abstracting from such crucial institutional structures as organization, distribution of power, value systems and preferences of decision making agents in control of power, and the processes by which the conflicts of preference functions are resolved within a socioeconomic system, can neither provide an adequate description of reality nor serve as a basis for realistic policy.

The main objective of this paper is to throw some light on the methods of resolving conflicting preferences on individual, organizational and societal levels and on the strategic factors which determine these diverse methods. The analysis presented in this study should be considered as a tentative and partial attempt to contribute to a complex theoretical model which is being formulated to describe the phenomena contained in the proverbial "black boxes".

## *Resolution of Conflicting Preferences Within an Individual*

Individuals are not single-motivated beings; they can be pulled in different directions by conflicting goals. Moreover, society is not an atomistic collection of individuals but consists of interacting organized behavior systems [1], with individuals filling different roles within them. In Parson's

[1] ALDERSON (1957, p. 25).

words, "role expectations and sanctions do exert pressures on individual actors which may generate types of strain" [2]. Since an individual can find himself under the stress of conflicting role expectations, he must reconcile these conflicting demands on his scarce resources such as time, energy, level of efforts and the like. This resolution of conflicting preferences can take the form of compromise, coercion (internal), or a combination of coercion and compromise.

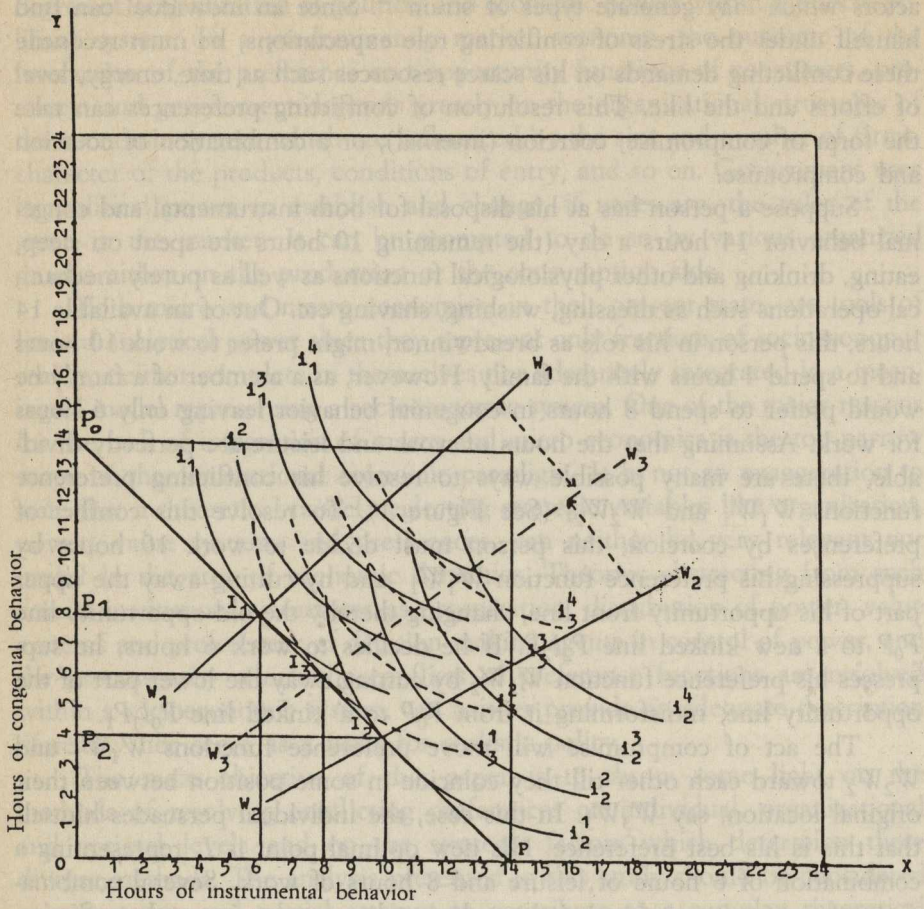
Suppose a person has at his disposal for both instrumental and congenial behavior 14 hours a day (the remaining 10 hours are spent on sleep, eating, drinking and other physiological functions as well as purely mechanical operations such as dressing, washing, shaving etc. Out of an available 14 hours, this person in his role as breadwinner, might prefer to work 10 hours and to spend 4 hours with the family. However, as a member of a family he would prefer to spend 8 hours in congenial behavior leaving only 6 hours for work. Assuming that the hours of work and leisure are perfectly dividable, there are many possible ways to resolve his conflicting preference functions $W_1W_1$ and $W_2W_2$. (See Figure 1). To resolve this conflict of preferences by coercion, this person must decide to work 10 hours by suppressing his preference function $W_1W_1$ and by cutting away the upper part of his opportunity front line, changing thereby the old opportunity line $P_0P$ to a new kinked line $P_2I_2P$. If he decides to work 6 hours, he suppresses his preference function $W_2W_2$ by cutting away the lower part of the opportunity line, transforming it from $P_0P$ to a kinked line $P_0I_1P_1$.

The act of compromise will move preference functions $W_1W_1$ and $W_2W_2$ toward each other till they coincide in some position between their original location, say $W_3W_3$. In this case, the individual persuades himself that this is his best preference. His new optimal point is $I_3$ representing a combination of 6 hours of leisure and 8 hours of work. Several combinations of persuasion and coercion can be used to resolve internal conflicting preferences.

The distinction between the methods of coercion and persuasion is much clearer in the case of organizations coercing individuals and sovereign states coercing both individuals and organizations within it. In the case of an individual, the distinction is not so sharp. It is significant in so far as internal coercion leaves an individual in a state of discontent, whereas internal persuasion does not. Moreover, the problem in real life might be complicated by discontinuities in the opportunity function caused by the lumpiness of employment opportunity (8 hours a day or none), as well as by the

[2] PARSONS and SHILS (1954, pp. 23-24).

FIGURE 1. Resolution of Individual's Conflicting Preference Functions




$P_0P$ - Opportunity frontier.
$W_1W_1$ and $W_2W_2$ - Conflicting preference functions within an individual.
$W_3W_3$ - Resultant preference function of an individual derived by the method of internal persuasion.

existence of other intervening factors such as a minimum income needed to sustain the family, the considerations of cultural versus material achievements and so on.

*Organizational Problems of Consent*

Conventional economic theory views the behavior of the firm or household as the behavior of a single individual. It tends to downplay or even ignore the crucial problem of how potentially conflicting preference functions of the members of an organization converge (problem of consent). How are the conflicting preference functions of individuals within the organization resolved without endangering its survival, for no organization can continue to exist unless its members are willing to serve its purposes.

Since the persons in organizational roles have their own preferences which might or might not coincide with the ends and purposes of the organization, a range of possible relationships among the individual and organizational ends might exist. Some persons might be using the organization simply as an instrument for the attainment of their private goals, while others might be willing to completely sacrifice their own private goals for the organization. Between these two extremes lies the majority of members who attempt to balance personal and organizational preferences. To attain organizational goals, management can use methods of persuasion, methods of coercion or some combination of the two. The method of persuasion consists of resorting to what Boulding calls the organizational "attractive power", that is, "the ability of organization to attract voluntary allegiance and support" [3]. This method can be used to enhance closer identification of organizational and individual purposes. This is a method of persuasion whereby a person's preference function shifts toward the organizational preference function. Another way of persuasion is the use of incentives which involves changes in an individual's opportunity function in order to shift his preference closer to that of the organization.

In addition to persuasion or instead of it, organization can use coercive power defined by Boulding as "the ability of organization to defend itself by influencing the behavior of those within its sphere of influence by fear of possible injury" [4]. This is achieved by cutting the organizational opportunity function in such a way as to move an individual's optimal point to a tangency of a lower indifference curve with a new "cut-off" opportunity line. Coercion in its purest form is seldom used. Boulding points out the existence of a "threshold of unwillingness below which no amount of coercive power can force an individual to contribute" [5]. Coercion nurtures discontent and strong discontent is a powerful weapon which, if combined

[3] BOULDING (1953, p. 216).
[4] *Ibid.*, p. 216.
[5] *Ibid.*, p. XXXII.

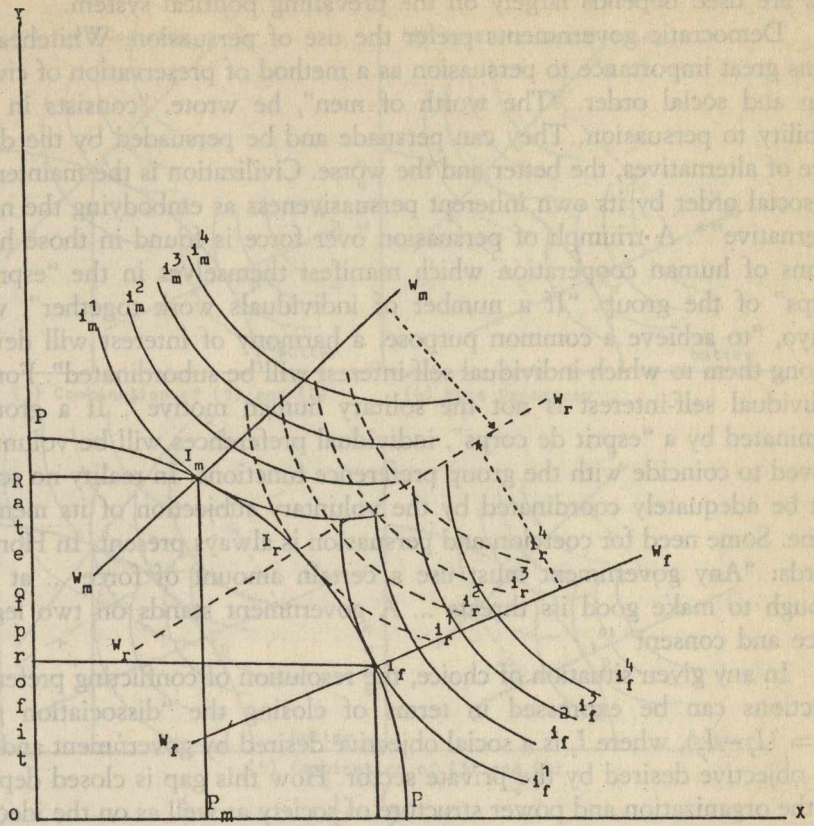
with power, can lead to organizational and sociopolitical changes. As Boulding sees it, "coercion involves suppression of discontent, not its alleviation. Coerciveness therefore involves minimizing the discontent of the exercisor of coercion at the cost of perpetuating the discontent of the coerced" [6]. Coercion can lead to "antagonistic cooperation", a state in which the members of an organization do just as much as they must or even as little as they can get away with.

Most organizations use some combination of coercion and persuasion. Since only a fool uses more force than is necessary, coercion is usually kept to a minimum. Perfect persuasion is achieved when the persuaded person works perfectly toward organizational goals in the firm belief that this is exactly what he desired in the first place.

The methods of resolving conflicting preference functions actually used, depend on the type of organization. The totalitarian or autocratic organization tends to use more coercion than persuasion, the latter taking the form of a centrally directed propaganda used to change an individual's preference functions to comply with organization's interest. Coercion usually fills the gap between the desired goal and the results achieved by propaganda. Theoretically, in democratic organizations, the top leadership attempts to formulate organizational preference functions in as close as possible conformance with the wishes of the majority of the members. In the political arena this is done by circularity of the hierarchical structure. This is done by "subordinating the executives at the top to the political will of the masses at the bottom" [7]. Figure 2 is a simple illustration of organizational methods of resolving conflicting preference functions of management and the owners of factors of production. If persuasion leads to a modification of mutual preference functions the resultant reconciled preference function is $W_rW_r$. If however, management does not yield an inch from its preferred position $W_mW_m$, and forces the factor owners to accept management's position unmodified, the former will face a new kinked opportunity frontier $PI_mP_m$. The part $I_mP$ of the original opportunity function $PP$ is now unattainable to the factor owners; the new optimum point of the latter is now point $I_m$ (desired optimum point of management), where the factor owners' lower indifference curve is just tangent to the new kinked opportunity line $PI_mP_m$. If some combination of coercion and persuasion is used, the reconciled optimal point will be somewhere between $I_m$ and $I_f$.

[6] *Ibid.*, p. 83.
[7] *Ibid.*, p. XXXIII.

FIGURE 2. Resolution of Conflicting Preference Function Within an Organization




Percentage of revenue paid to owners of factors

$W_mW_m$ - Management's preference function.
$W_fW_f$ - Preference function of owners of factors of production.
$W_rW_r$ - Reconciled preference function by method of persuasion.
$i_m$ - Management's indifference curves.
$i_f$ - Owners of factors' indifference curve.
$PP$ - The opportunity function of the organization.

## *Resolution of Conflicting Preferences on the Societal Level*

Organizations and social groups within a society can pursue different, sometimes even conflicting goals. If society as a whole is to preserve its unity and integrity, the conflicting preference functions of social groups, organizations and sectors must be reconciled. The methods to achieve this

purpose are persuasion, coercion or some combination of both. What methods are used depends largely on the prevailing political system.

Democratic governments prefer the use of persuasion. Whitehead assigns great importance to persuasion as a method of preservation of civilization and social order. "The worth of men", he wrote, "consists in their liability to persuasion. They can persuade and be persuaded by the disclosure of alternatives, the better and the worse. Civilization is the maintenance of social order by its own inherent persuasiveness as embodying the nobler alternative" [8]. A triumph of persuasion over force is found in those higher forms of human cooperation which manifest themselves in the "esprit de corps" of the group. "If a number of individuals work together", wrote Mayo, "to achieve a common purpose, a harmony of interest will develop among them to which individual self-interest will be subordinated". For him individual self-interest is not the solitary human motive [9]. If a group is dominated by a "esprit de corps", individual preferences will be voluntarily moved to coincide with the group preference functions. In reality no society can be adequately coordinated by the voluntary subjection of its members alone. Some need for coercion and persuasion is always present. In Homan's words: "Any government must use a certain amount of force ... at least enough to make good its threats ... A government stands on two legs of force and consent" [10].

In any given situation of choice, the resolution of conflicting preference functions can be expressed in terms of closing the "dissociation gap", $G_s = (I_s - I_p)$, where $I_s$ is a social objective desired by government and $I_p$ is the objective desired by the private sector. How this gap is closed depends on the organization and power structure of society as well as on the ideology of those in control of power. Five methods of combining persuasion with coercion is discussed: (1) pure coercion; (2) absolute conditioning; (3) a combination of (1) and (2); (4) pure democracy; (5) the hybrid method - a combination of (3) and (4).

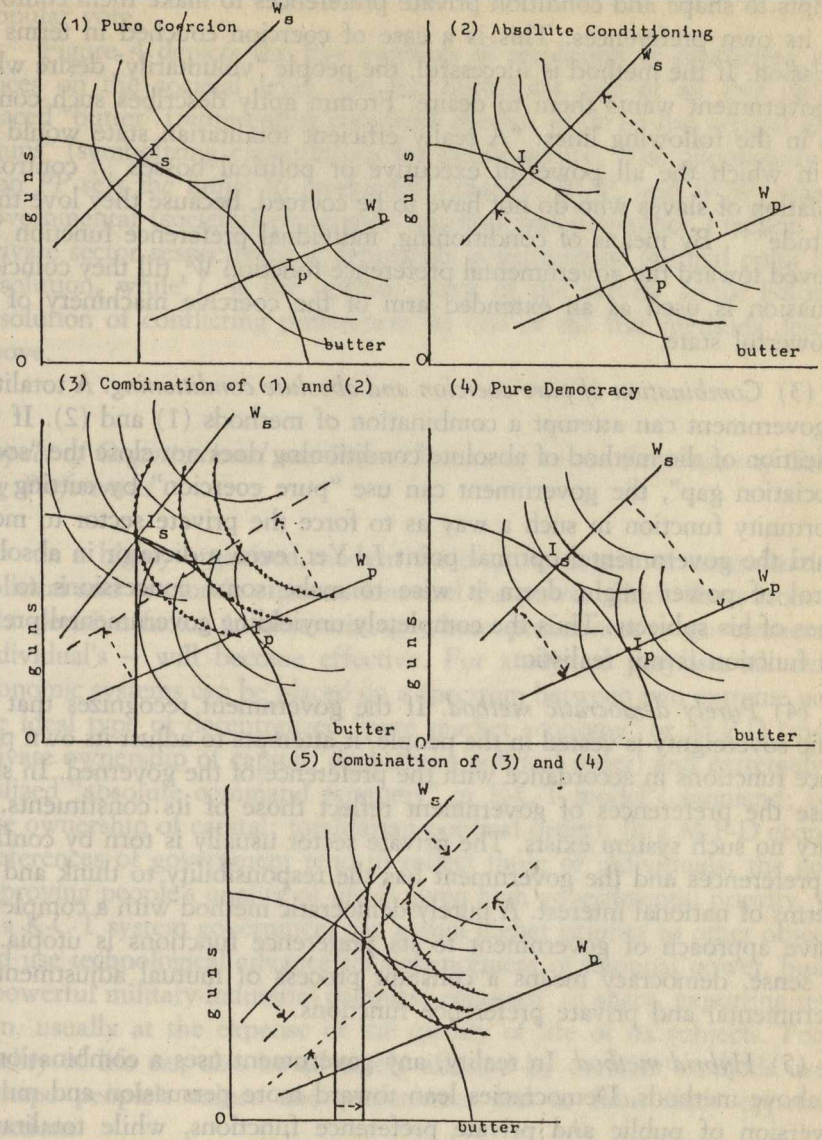
(1) *Pure coercion method.* A government using this method ignores the preference of individuals, groups and organizations and sets unilaterally the goals to be attained. In terms of the "social dissociation gap" the government will hold its preference $I_s$ constant, ignore the preference of the private sector $I_p$ and cut off that part of opportunity function which could

[8] Whitehead (1933, p. 105).

[9] Mayo, *The Political Problem of Industrial Civilization*, p. 21, cited in Homans (1950, p. 91).

[10] Homans, Curtis (1934, p. 255).

FIGURE 3. Resolution of Conflicting Preference Functions on Societal Level




have made the attainment of $I_p$ possible. (See Figure 3). The use of this extreme method of coercion is not very frequent. Even the most tyrannical rulers use some elements of persuasion and find it wise to economize their use of force.

(2) *Method of absolute conditioning.* The government using this method attempts to shape and condition private preferences to make them conform with its own preferences. This is a case of coercion couched in terms of persuasion. If the method is successful, the people "voluntarily" desire what the government wants them to desire. Fromm aptly describes such conditions in the following lines: "A really efficient totalitarian state would be one in which the all powerful executive or political bosses ... control a population of slaves who do not have to be coerced, because they love their servitude" [11]. By means of conditioning, individual preference function $W_p$ is moved toward the governmental preference function $W_s$ till they coincide. Persuasion is used as an extended arm of the coercive machinery of an all-powerful state.

(3) *Combination of pure coercion and absolute conditioning.* A totalitarian government can attempt a combination of methods (1) and (2). If the application of the method of absolute conditioning does not close the "social dissociation gap", the government can use "pure coercion" by cutting the opportunity function in such a way as to force the private sector to move toward the governmental optimal point $I_s$. Yet, even a dictator in absolute control of power might deem it wise to make some concessions to the wishes of his subjects. Thus the completely unyielding governmental preference function is not realistic.

(4) *Purely democratic method.* If the government recognizes that supreme sovereignty is vested in the people, it attempts to adjust its own preference functions in accordance with the preference of the governed. In such a case the preferences of government reflect those of its constituents. In reality no such system exists. The private sector usually is torn by conflicting preferences and the government has the responsibility to think and act in terms of national interest. A purely democratic method with a completely passive approach of government to its preference functions is utopia. In this sense, democracy means a constant process of mutual adjustment of governmental and private preference functions.

(5) *Hybrid method.* In reality, any government uses a combination of the above methods. Democracies lean toward more persuasion and mutual conversion of public and private preference functions, while totalitarian regimes use centrally directed pseudo-persuasion methods combined with pure coercion. All systems have to use some element of coercion by the use of force. Even in the best democracies, some irreducible amount of coercion

[11] Fromm (1955, p. 226).

is needed to preserve freedom of choice and to enforce decisions made by popular vote.

Figure 4 depicts the five methods of resolution of conflicting preferences on the societal level. On the horizontal axis of all five panels is placed "butter" (representing consumer goods), while on the vertical axis are "guns" (symbolizing expenditures for public goods). The opportunity function *PP* sets the limits to productive capacity; $W_sW_s$ and $W_pW_p$ stand for governmental (societal) preference function and preference function of the private sector respectively. $I_s$ represents governmental optimal point before resolution, while $I_p$ is the optimal point of the private sector before the resolution of conflicting preferences by one of the five methods described above.

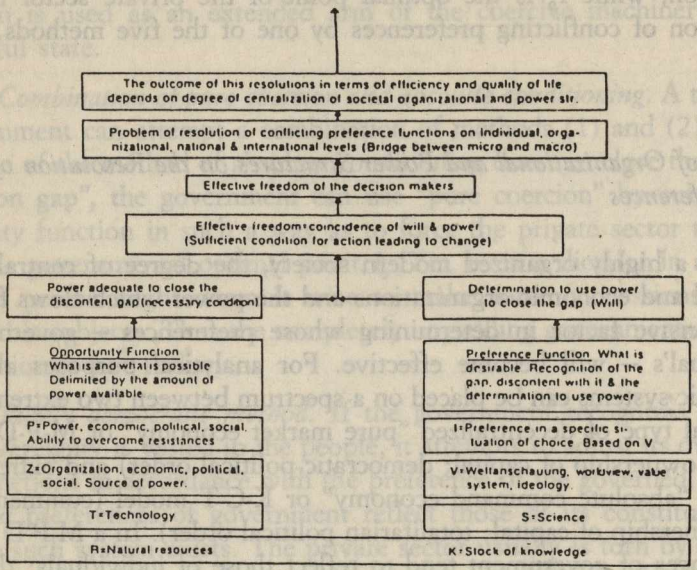
*Impact of Organizational and Power Structures on the Resolution of Conflicting Preferences*

In a highly organized modern society, the degree of centralization of political and economic organizations and the power which flows from them is a decisive factor in determining whose preferences – government's or individual's – will become effective. For analytical purposes all existing economic systems can be placed on a spectrum between two extreme poles – the ideal type of decentralized "pure market economy" or M-P-D (market: private ownership of capital; democratic political order) and extremely centralized "absolute command economy" or K-C-T model (command; collective ownership of capital; totalitarian political order). In a M-P-D economy, preferences of government tend to reflect those of individuals: the goal of improving people's quality of life is given high governmental priority, while in a K-C-T system government can assign higher priority to other objectives and use technological advance for enhancement of national power, building a powerful military-industrial complex, conquest of space, exporting revolution, usually at the expense of the quality of life of its subjects. People's quality of life can also be adversely affected by coercive methods used to reshape people's values and preferences and to limit their opportunity functions.

A systematic analysis of the essential characteristic of these pure models is carried on six levels: *Z-level* – organization; *P-level* – power; *V-level* – value systems (ideologies); *I-level* – preferences; *F-level* – effective freedom; and *Q-level* – quality of life (see Figure 4). Logical inferences from this analysis are: in an M-P-D model of extreme decentralization, political and

FIGURE 4. Individual vs. Government Preferences, Efficiency and Quality of Life

| Ideal type of Pure Market Economy<br><br>Extreme Decentralization<br><br>M-P-D | Technological advance directed toward attainment of quality of life with optimal efficiency subordinated to this major objective | M-P-D | | K-C-T | | Technological advance is primarily directed toward technical efficiency in attainment of governmental goals at the expense of people quality of life pense of people's quality of life | Ideal type of Absolute Command Economy<br><br>Extreme Centralization.<br><br>K-C-T |
|---|---|---|---|---|---|---|---|
| | | Oo → Eo | Efficiency subordinated to quality of life | Eo → Oo | Quality of life sacrificed to efficiency | | |
| | | Fi → Fg | Effective freedom of people prevails | Fg → Fi | Governments effective freedom prevails | | |
| | | Ii → Ig | Individual preferences prevail | Ig → Ii | Governments preferences prevail. | | |
| | | Vi → Vg | Individual preferences prevail | Vg → Vi | Governments ideology prevails | | |
| | | Pp ⟷ Pe | Separation of political from econ. P | Pp → Pe | Political power dominates economic p. | | |
| | | Zp ⟷ Ze | Separation of political from ec. org | Zp → Ze | Political organiz. dominates econ. org | | |




economical organizations are separated; so are economic and political powers; governmental value systems tend to reflect individuals' value systems; government's preference functions tend to reflect preferences of individuals and the field of individual effective freedom is relatively broad; attainment of quality of life will take precedence over the quest for pure efficiency. In the K-C-T model of extreme centralization, political organization controls and dominates economic organization; political and economic power is fully controlled by the government; government ideology controls the value systems of individuals and most of the effective freedom is enjoyed by the rulers. In terms of quality of life of individuals: in a K-C-T system, technological advance is used to advance governmental goals typically at the expense of people's quality of life [12].

[12] MIECZKOWSKI and ZINAM (1984, p. 19).

The lower panel of Figure 4 outlines some crucial elements of the theory of social change based on the interaction of preference and opportunity functions and on the relationship between power and will (determination to use power). The preference function is influenced by value systems (Weltanschauung), and can lead to the determination to act (will), while the opportunity function is limited by the amount of power available, which, in turn, flows from organization. Coincidence of power and the will to use it, makes preference effective and represents sufficient condition for change, while will and power taken separately, are necessary conditions for change. On the preference side, the determination to use power is preceded by the sequence of (1) recognition of the gap between ideal and actual values (level of aspiration and level of attainment); cathection of this gap (discontent); and volition to use available power to close the discontent gap. At the heart of this model is a theory of discontent developed elsewhere [13]. To move from this essentially micro-analysis to a level of macro-analysis, it is necessary to deal effectively with the problem of resolving conflicting preferences of the decision-making units on the individual, organizational and societal levels. How they are resolved depends primarily on the organizational and power structure of the units involved in the conflict of preferences [14].

*The Impact of Conflict Resolutions on Quality of Life*

In modern society, the size and power of state, business and social organizations are on the rise. Large impersonal organizations represent a major source of power. Most of these organizations are bureaucracies defined as formal organizations "characterized by the rational operation of a hierarchical authority structure and explicit procedural rules" [15]. It is the most efficient way to organize efforts of a large number of people for the attainment of objectives which differ from the goals of its individual members. A bureaucratic organization provides a system of incentives, rewards and sanctions to induce its members to work for organizational objectives. National governments are the largest and the most powerful bureaucracies in the world.

Max Weber was convinced that "the dynamism of the capitalist process inevitably resulted in a steady growth of more and more gigantic

[13] ZINAM (1970, 1971).
[14] ZINAM (1974, p. 329).
[15] *Encyclopedia of Sociology* (1974, p. 30).

bureaucratic structures" [16]. Though he believed that bureaucratic organization is one of the essential characteristics of modern capitalism, he did not think that it is its exclusive property. Bureaucracy is present in any society which is so organized that its goals constitute impersonal ends to its members. In his view, all socialist policies were "bound to foster bureaucratization and ossification of society" [17].

The emergence of the Soviet Union after WWI and of a dozen or so other command economies after WWII, all of them highly centralized public bureaucracies, reinforced the general trend toward further enlargement and depersonalization of organizational structures. The excessively large size of industrial firms was caused by the "gigantomania" of the leaders and a need for reducing the cost of central administration by an increase in the size of the units and a decrease in their number.

Between quality of life and the ideology which affects it, on the one hand, and natural and human resources as well as technology, on the other, lies a societal, organizational and power structure (bureaucracy). As depicted in Figure 5, the bureaucratic structure of an economy can have both an *indirect* and a *direct* effect on the quality of life. Organization and power structures guided by the ideology of their leadership can affect quality of life indirectly by the choice of national goals or national priorities and by determining the ways technology and scarce resources are used. If the power elite in a totalitarian state assigns people's quality of life a low priority, while pursuing as its major goals world domination, military superiority and enhancement of its own power and using technology and resources accordingly, – this will have an indirect (and probably detrimental) effect on people's quality of life. Moreover, the mere existence of an oppressive totalitarian bureaucracy deprives constituents of their freedom, human rights, and human dignity. This constitutes a direct effect of bureaucratic structures on quality of life. Both effects must be assessed before an adequate judgement of the total impact of a societal organization and power structure on quality of life is made.

### *Utopias, Dystopias and Paradigmatic Myopia*

A public policy based on a paradigm defective either in its scope or method, or both, can lead to outcomes which will produce results contrary

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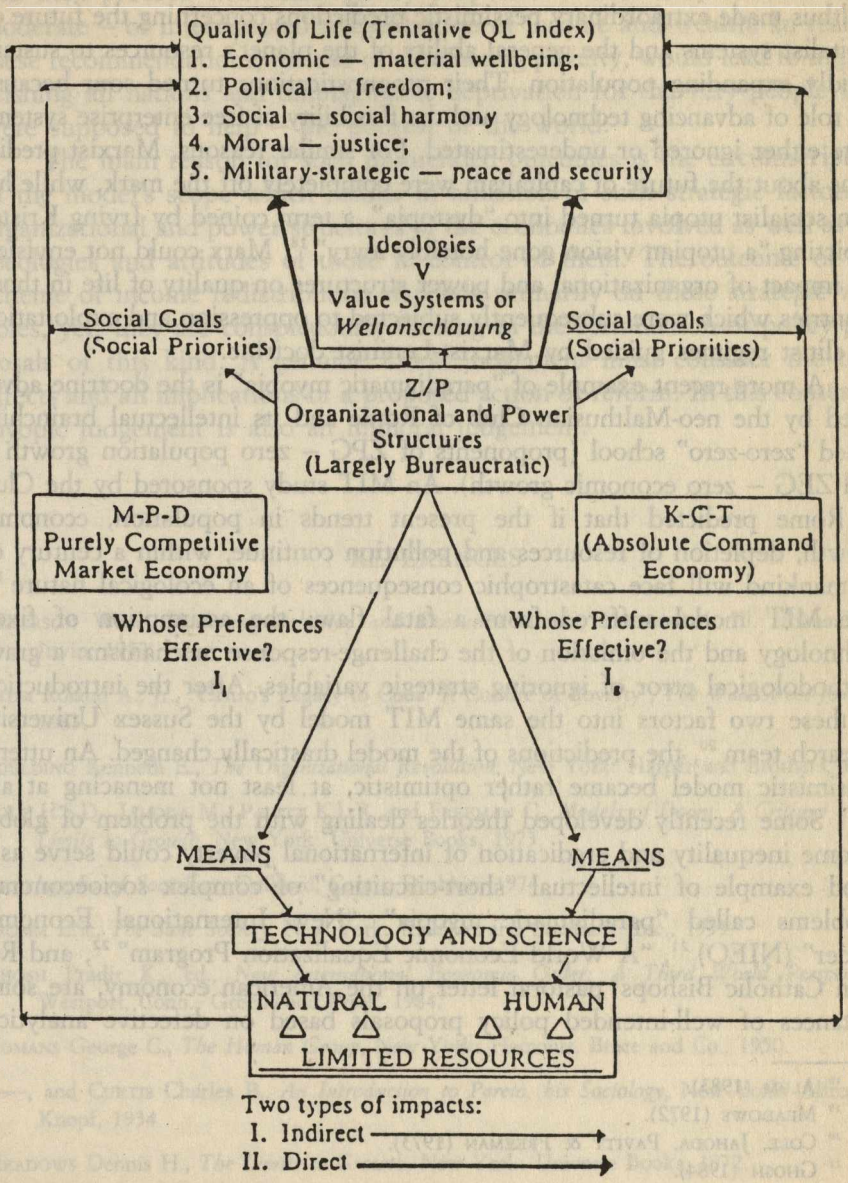
[16] MOMMSEN (1974, p. 107).

[17] *Ibid.*, p. 109.

FIGURE 5. Impact of Organizational and Power Structures on the Use of Technology and the Quality of Life



to the intentions of policy makers. Sociologists call this phenomenon "latent function". Historically, many "grand" theories failed in their predictions primarily because of missing key variables or downplaying some of them since they are considered either unimportant or irrelevant. Thus Ricardo and Malthus made extraordinary pessimistic predictions concerning the future of capitalist systems and the general ability of the planet's resources to sustain rapidly expanding population. Their prognostications turned sour because the role of advancing technology and the flexibility of free enterprise systems were either ignored or underestimated. For similar reasons, Marxist predictions about the future of capitalism were completely off the mark, while his own socialist utopia turned into "dystopia", a term coined by Irving Kristol depicting "a utopian vision gone horribly awry" [18]. Marx could not envision the impact of organizational and power structures on quality of life in those countries which were subsequently subjected to oppression and exploitation by elitist regimes guided by Marxist-Leninist doctrine.

A more recent example of "paradigmatic myopia" is the doctrine advocated by the neo-Malthusian Club of Rome and its intellectual brainchild called "zero-zero" school (proponents of ZPG – zero population growth – and ZEG – zero economic growth). An MIT study sponsored by the Club of Rome predicted that if the present trends in population, economic growth, depletion of resources and pollution continue, within a century or so mankind will face catastrophic consequences of an ecological nature [19]. The MIT model suffered from a fatal flaw: the assumption of fixed technology and the omission of the challenge-response mechanism: a grave methodological error of ignoring strategic variables. After the introduction of these two factors into the same MIT model by the Sussex University research team [20], the predictions of the model drastically changed. An utterly pessimistic model became rather optimistic, at least not menacing at all.

Some recently developed theories dealing with the problem of global income inequality and eradication of international poverty could serve as a good example of intellectual "short-circuiting" of complex socioeconomic problems called "paradigmatic myopia". "New International Economic Order" (NIEO) [21], "A World Economic Equalization Program" [22], and Roman Catholic Bishops' pastoral letter on the American economy, are some instances of well-intended policy proposals based on defective analytical

[18] ALUM (1983).
[19] MEADOWS (1972).
[20] COLE, JAHODA, PAVITT & FREEMAN (1973).
[21] GHOSH (1984).
[22] YUNKER (1987).

models. Intellectual constructs of this type typically start with statistical data confirming economic inequities in income and wealth distribution, move to a high ethical ground of moral indignation with such intolerable conditions and then proceed with hasty policy proposals – some drastic, some more moderate – of international redistribution of income and wealth. In reality, these recommendations, instead of eliminating poverty, would lead to impoverishing all nations and unimaginable deprivation for the very people they were supposed to help – the poorest of the world.

The main reason for such unintended outcomes is the circumscription of the model's scope which results in omission of such strategic factors as organizational and power structures of the economies involved as well as the ideologies and attitudes of those in control of them. The outcome of any scheme of income redistribution depends primarily on these strategic variables, yet, they are conspicuously missing in the formulation of policy proposals of this kind. A genuine moral judgement must consider the total effects and all implications of a proposed action or reform. In this context, a myopic judgement is also an immoral judgement.

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## SULLA RISOLUZIONE DI CONFLITTI DI PREFERENZE, SCATOLE NERE DEGLI ECONOMISTI E MIOPIA PARADIGMATICA

Le assunzioni della teoria neoclassica convenzionale escludono dall'analisi economica il problema socioeconomico più complicato di risolvere il conflitto fra funzioni di preferenze per individui, famiglie e imprese, per istituzioni private e pubbliche e per la società come un tutto. In uno spirito di comportamentismo psicologico gli economisti tradizionali hanno confinato questo problema in « scatole nere » concettuali. Il modello « stimolo-risposta » dei comportamentisti è stato adattato alla teoria economica nella forma delle « preferenze rivelate ». La conseguente omissione di variabili strategiche come organizzazione, potere, ideologia e preferenze, le loro importanti interrelazioni e il loro impatto su altre variabili economiche hanno troncato il paradigma tradizionale e limitato severamente le possibilità previsionali dei suoi strumenti teorici. Come risultato, diverse, altrimenti brillanti, « grandi » utopie sono diventate distopie causando sofferenze impreviste a coloro che avrebbero dovuto esserne i principali beneficiari.

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# THE SUBSTITUTION OF MACHINERY FOR LABOUR AND "THE TWO RICARDO EFFECTS"

by
STEFANO PERRI *

## *Introduction*

Ricardo, as it is well known, developed his own theory of value in opposition to Smith. The prices of goods do not depend on the distributive shares of the national product. They are determined by the quantity of labour which is necessary for the production of commodities. According to this theory, a rise in the wage-rate does not result in general into a rise in prices, because profits fall to produce a balancing effect.

Generally speaking, however, the proportion between fixed and circulating capital and the durability of capital are not the same in all the sectors of production. Ricardo, while writing his *Principles*, realized that in these cases a rise in the wage-rate does cause a change in relative prices.

Profits amount to a high share of the price of those goods in which a large quantity of fixed capital is used. Thus a rise in the wage-rate causes what Ricardo called the "curious effect", namely the fall in "the price of those commodities which are chiefly obtained by the aid of machinery and fixed capital" relative to the other goods, because of the consequent fall in profits [1]. It will be noted that either an increase in the "difficulty of production" of corn and the consequent change in distribution, real wages remaining unchanged (the "Ricardian case"), or changes in real wages

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[1] Letter to Mill, 14 Oct. 1816. RICARDO (1951-1973, vol. vii, pp. 82).

in face of a given technology (the "Neo-Ricardian case") can cause the "curious effect".

Professor Hayek coined the phrase the "Ricardo effect", but he did not make any reference to the variations in prices caused by a rise or fall in wages. By the "Ricardo effect" he meant a substitution of machinery for labour in response to a change in real wages [2].

Schumpeter called "Ricardo effect" both the changes in prices due to a rise or fall in wages ("a curiously devious way of admitting something of which one does not wish to admit the implications" [3]) and "the manifold relations of substitution that exist within the universe of technological capital", viz. "the cases of conversion of circulating into fixed capital" [4]. But these are two different economic processes.

Usually a variation in the price of commodities in response to a change in the distribution of the national product is called the "curious effect" by Ricardian scholars and the substitution of machinery for labour when the wage-rate rises is called the "Ricardo effect" [5]. Nevertheless the controversy about Hayek's interpretation of Ricardo seemed to draw the conclusion that the "Ricardo effect" is influenced by the "curious effect". According to this interpretation, Ricardo would suppose that the production of wage-goods was labour-intensive relative to the production of machinery, so that an increase in the wage-rate would lead to a decrease in the price of machinery. On the contrary, if the machine was produced in more labour-intensive sectors than the wage-goods, the rise in the wage-rate would cause the relative price of machinery itself to rise. It would not become profitable to employ machinery instead of workers when the rate of profit falls [6].

In this paper I shall not deal with the unemployment effects from the introduction of different methods of production. I shall analyze Ricardo's theory of the substitution of machinery for labour as developed in Section V of Chapter I *On Value*. I shall offer a proof that the "Ricardo effect" does not depend on the "curious effect". The controversy about Hayek's analysis pointed out the effects of an increase in real wages, while Ricardo dealt with

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[2] See HAYEK (1939, p. 88 ff.). Hayek also analysed the "Ricardo effect" in other essays. See HAYEK (1942 and 1969).

[3] See SCHUMPETER (1954, p. 595). Ferguson stated this was a lucid description of "Hayek's Ricardo Effect" (FERGUSON, 1973, p. 8). As it will be shown below, this statement derives from Ferguson's interpretation of Ricardo's analysis.

[4] SCHUMPETER (1954, p. 637).

[5] See HOLLANDER (1971, p. 105 and p. 114) and BLAUG (1968, p. 490 ff.).

[6] Blaug deals with an increase in money wages, the general level of prices remaining unchanged. Ferguson deals with an increase in real wages. See BLAUG (1968, p. 90 and p. 491) and FERGUSON (1973).

an increase in the amount of labour employed in the production of wage-goods, given real wages. Both these cases, however, do not require, as far as the "Ricardo effect" is concerned, any particular assumption about the combination of fixed and circulating capital or about the durability of capital either in the production of wage-goods or of machinery. In fact the price of machines always falls relative to the wage-rate when the latter rises.

Ricardo seemed to relate "changes in the input proportions and changes in their prices" [7]. In his analysis, in fact, techniques with higher "capital intensity" become profitable when the profit rate falls. He, however, assumed that machines can only substitute direct labour. This is a change in technique which lacks "ambiguousness". Given this assumption, the possibility of a reswitching of techniques is excluded and Ricardo's analysis is implicitly confirmed by Sraffa in *Production of Commodities by Means of Commodities*. Therefore the substitution of machinery for labour in Ricardian economics greatly differs from the substitution of capital for labour in Neo-classical economics.

## 1. *Ricardo on the Substitution of Machinery for Labour*

Ricardo's ideas about substitution of machinery for labour are well-known. He supposed that a machine, which lasts for a year, can do the work of one hundred men in a year. At first the machine costs the same as the wages paid to the workers, so that capitalists can employ the men or the machine indifferently.

In Ricardo's example the machine costs 5000 l., while the wage of one man for a year amounts to 50 l. It will be noted that no assumption is made about the quantity of labour required to produce the commodity. Only the given amount of direct labour which the machine can replace is known.

If the wage-rate rises it would be in the capitalists' interest to employ the machine instead of the workers. In fact, the machine would now cost less than the men. In Ricardo's words:

> The machine itself cannot rise in price. It would rise in price if there were no stock employed on its construction, and no profits to be paid to the maker of it [...] But this cannot be the case; less than one hundred men are employed or it could not be sold for 5000 l., for out of the 5000 l. must be paid the profits of the stock which employed the men [8].

[7] As Pasinetti maintains, generally "changes in the input proportions and changes in their prices are entirely unrelated" (PASINETTI, 1977, p. 392).

[8] RICARDO (1951-1973, vol. i, pp. 40-41).

Moreover, the capitalists who employ the machine cannot sell their commodities at the same price. Their costs of production are not increased but the rate of profit is now diminished. Owing to Ricardo's "curious effect", the prices of these commodities must fall [9].

Ricardo points out the variations which exist between the relative prices of machinery and labour and between the prices of commodities which are produced with the aid of machinery and those which are chiefly produced by "unassisted" labour. A rise in the price of wage-goods causes a rise in the "real value" of wages. The relative price of the machine diminishes compared to the wage-rate, while the relative prices of the commodities produced with more "capital-intensive" processes fall compared to other goods.

The most remarkable difference between these passages and those contained in editions 1 and 2 of the *Principles* is that in the early editions the manufacturer who employs the machine is a hatter [10]. Ricardo in fact did not substantially alter his statements about this matter, although he changed his opinion about the effects of machinery on working-class interests [11].

## 2. *The "Hayek Story"* [12]: *The Controversy on the Interpretation of the "Ricardo Effect"*

Hayek called "Ricardo effect" "the familiar proposition that a rise in wages will encourage capitalists to substitute machinery for labour and vice versa" [13]. He was challenging Keynesian economics and trying to work out an analysis of the economic cycle based on the Austrian School's theory of capital. He pointed out that a fall in real wages causes the substitution of labour for machinery.

Hayek's "Ricardo effect" works during the last stages of a boom. The increase in the demand for consumer goods causes their prices to rise. According to Hayek, nominal wages do not increase proportionally, so that real wages fall and the rate of profit rises.

In Hayek's model there are many different processes for producing wage-goods, each with a different "time which must elapse before the com-

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[9] See RICARDO (1951-1973, vol. i, p. 42).

[10] See RICARDO (1951-1973, vol. i, p. 61).

[11] On the evolution of Ricardo's analysis on the relationship between the employment of machinery and the employment of labour see HOLLANDER (1971) and SRAFFA (1951, pp. lvii-lx).

[12] This phrase is by HICKS (1967, p. 202).

[13] HAYEK (1939, p. 8).

modity can be brought to the market" [14]. Since equilibrium prevails, each process yields the same rate of profit per year. When real wages decrease the difference between the product of labour and the goods advanced to the workers rises proportionally for all processes. Thus the rate of profit per year increases much more when there are shorter periods of turnover of capital. Two contrasting tendencies result. On the one hand the demand for investment increases owing to the rise in profits. On the other hand capitalists are encouraged to use less capital-intensive processes in consequence of the "Ricardo effect". When the latter tendency prevails over the former the total demand for capital goods decreases and the boom changes into recession [15].

Several authors proved that "Ricardo and Hayek are poles apart from the standpoint of the causality system underlying their analyses" [16]. While Ricardo deals with positions of long-run general equilibrium, Hayek stresses short-run consequences of the "Ricardo effect" [17]. As Kaldor pointed out, in opposition to Ricardo, Hayek

> does *not* assume any change in the relative prices of labour and machinery, or any change in the rate of interest, or any necessary tendency for equality in the rates of profit earned in different industries [18].

Moreover Hayek supposed that real wages changed. On the contrary Ricardo supposed that the "real value of labour" (and thus nominal wages) rose, real wages remaining unchanged.

Kaldor, however, put forward another argument which cannot be regarded as strictly consistent with the former:

> It is clear that Ricardo's argument (as distinct from the "Ricardo effect") is really the same as the familiar Austrian proposition that when the rate of interest rises, the cost of production, and hence the prices, of goods containing more capital will

[14] HAYEK (1939, p. 8) quoted from RICARDO (1951-1973, vol. i, p. 37).

[15] HAYEK (1939, p. 33).

[16] FERGUSON (1973, p. 11).

[17] See HAYEK (1942, p. 129), where the author wrote he was pointing out "short run rather than long run effects of 'the Ricardo Effect' ". According to Moss and Vaughn it is possible to identify two approaches to the substitution of machinery for labour in Ricardo. In chapter 1, section V of the *Principles* he compares two equilibrium states – before and after a change in wages has induced a switch in production techniques. In chapter XXXI *On Machinery* he analyzes the path which is followed when an economy reestablishes equilibrium after a disequilibrating shock. As already stated, the present paper does not deal with the interpretation of chapter XXXI. See MOSS and VAUGHN (1986, pp. 548-51).

[18] KALDOR (1960, p. 157).

rise relatively to those containing less capital, and this will cause a *substitution of the latter for the former, all along the line* [19].

Probably influenced by this passage, several economists interpreted the "curious effect" as the cause of the "Ricardo effect". Blaug is unequivocal in the following passage:

Ricardo assumed that labor costs in the machine goods industry were below the general average in the economy as a whole, so that the rise in money wages did not produce a proportionate rise in the price of machines [20].

Ferguson too agreed with this interpretation:

[Ricardo's analysis] inevitably entails the assumption that the production of corn is labour-intensive relative to the production of machinery. I cannot find an explicit statement to this effect in Ricardo; but it is obviously required, for otherwise an increase in the real wage would increase the price of machinery by more than the price of corn [21].

The authors quoted above pointed out the relationship between the "curious effect" and the "Ricardo effect". When machinery is produced by more "labour-intensive" techniques than corn – they argued – its price rises after an increase in the wage-rate. Only when it is produced by more capitalistic techniques its price decreases and thus it becomes profitable to substitute machinery for labour.

## 3. *Ricardo's "Ricardo Effect"*

Actually Ricardo did not need to refer to the "curious effect" as the cause of the "Ricardo effect". If one agrees with the statement that wages and profits are inversely related, then the rise of the wage-rate is the direct cause of both the variation in prices and the substitution of machinery for labour. According to Ricardo if the value of corn increases, the wage-rate rises in value relative to all the other goods except corn. Thus wages rise relatively to the price of the machine, which previously had the same price

[19] KALDOR (1960, p. 156) my italics. More recently O'Driscoll pointed out that Hayek's interpretation of Ricardo is correct because it refers not only to the substitution of machinery for labour, but also to the "curious effect". See O' DRISCOLL (1975, pp. 262-63).

[20] BLAUG (1968, p. 491).

[21] FERGUSON (1973, p. 7).

as the corn paid to the workers who can be substituted by the machine. (Moreover, as I shall show in the next section, the price of machines always falls relative to the wage-rate even in the "Neo-Ricardian case", i.e. when real wages rise).

Indeed Ricardo's example entails assumptions that expressly contradict the interpretations in the previous section. In fact the machine is the product of the labour of eighty-five workers for a year. In the first edition of the *Principles* the period "which all things took to produce and bring to market (i.e. circulating capital to circulate)" was a year [22].

Hollander gave a lucid exposition of this matter:

> The presumption [...] is that machinery itself is produced by labour *alone*, that is without the use of fixed capital although supported by advances for a certain period, and the monetary medium again is evidently also presumed to be produced by labour alone [23].

That is why the price of the machine does not change when wages rise.

Ricardo did not need to change his analysis after the well-known alterations in the chapter *On Value* in editions 2 and 3 of the *Principles* [24]. Clearly he did not believe those alterations would lead to different conclusions about the price of machinery.

The period of a year suits the production of corn very well. Hollander pointed out that the machine, the monetary medium and the corn are produced by "unassisted" labour. However it must be noted that Ricardo assumed the same conditions of production for both wage-goods and machinery, with the aim of making his analysis easier. He thought that the conclusions he had drawn in this way held good even when wage-goods and machinery are produced with different proportions of fixed and circulating capital or with a different durability of capital.

Confusion cannot result from the passage in which Ricardo stated that the machine "would rise in price if there were no stock employed on its construction, and no profits to be paid to the maker of it" [25]. The wages advanced to the workers are stock and the profits are paid on the advanced wages. Ricardo merely asserted that both the machine and the wage-goods are produced under capitalistic conditions.

Actually Ricardo did not think that the price of machinery would

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[22] SRAFFA (1951, p. xlii).

[23] HOLLANDER (1971, p. 201 and p. 290).

[24] On the invariable measure see SRAFFA (1951, pp. xli-xlv).

[25] RICARDO (1951-1973, vol. i, p. 40).

increase relative to the price of wage-goods if it had been produced with more labour-intensive processes than the corn itself. He predicted that wages would rise, because the quantity of labour employed in the production of corn increases. Ricardo regarded the changes in the quantity of labour as the main cause of variation in the value of commodities so that Stigler ironically referred to his theory as "the 93 per cent labour theory of value" [26]. On the contrary the variation in the distributive shares is "comparatively slight in its effects" [27]. According to Ricardo the change in the quantity of labour employed in the production of goods is always the prevailing cause in determining the direction of the variation in relative prices. This statement, as far as the substitution of machinery for labour is concerned, is an analytical proposition, not an empirical one, because it can be analytically proved and therefore it is not merely based on empirical observations [28]. Thus an increase in the "difficulty of production" of corn always involves a decrease in the relative price of machinery.

## 4. *A Demonstration of Ricardo's Theory*

Ricardo's theory of the substitution of machinery for labour as a result of a rise in the wage-rate can be expounded in a rigorous way.

In the "Ricardian case" the cultivation of less productive lands causes the price of corn to rise. Thus the wage-rate increases and the profit rate falls. In the "Neo-Ricardian case" the wage-rate increases because real wages do rise. In both cases the consequent "curious effect" can never counteract the fall in the price of machinery relative to the wage-rate itself.

The argument is implicitly suggested by Sraffa in his *Production of Commodities by Means of Commodities*, when he was analysing the limits of the movement of prices due to a change in the distributive shares. In Sraffa's words:

> There is [...] a restriction to the movement of the price of any product: if as a result of a rise in the rate of profits the price falls, its rate of fall cannot exceed the rate of fall of the wage [29].

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[26] See STIGLER (1965, p. 326).

[27] RICARDO (1951-1973, vol. i, p. 36).

[28] With regard to the distinction between analytical propositions and empirical propositions in Ricardo's theory of value see STIGLER (1965, p. 333).

[29] SRAFFA (1960, p. 39).

It is possible to reverse the direction of the movement: if as a result of the fall in the rate of profits the price rises, its rate of rise cannot exceed the rate of rise of the wage. In other words the price of machines always falls relative to the wage-rate when the latter rises.

Sraffa's statement can be expounded in the following way with regard to the "Ricardo effect".

Ricardo's main assumption is that a machine can save a given amount of direct labour. The equality assumed by Ricardo at the beginning of his analysis between the price of the machine and the wages of labour which the machine can replace may be expressed by the following equation:

$$(1) \quad w[L_{m1}(1+r) + L_{m2}(1+r)^2 + \ldots + L_{mn}(1+r)^n] = wL$$

where $w$ is the wage-rate, $r$ the rate of profit, $l_{mt}$ the quantity of necessary labour employed in period $t$ of production of the machine and $L$ the quantity of "living" or direct labour that the machine can substitute. As $r$ is supposed to be positive, the quantity of total labour embodied in the machine must be smaller than the quantity of living labour $L$.

No other assumption needs to be made about the conditions of production of the commodity. Of course other labour is employed in the productive process besides that which is saved by the machine, but equation (1) only compares the price of the machine and the given amount of direct labour which the machine can substitute.

Let us suppose that $w$ rises to $w'$ and consequently $r$ falls to $r'$ (it is not necessary to specify why $w$ increases; the argument suits to the "Ricardian case" as well as to the "Neo-Ricardian case"). (1) changes into (1′):

$$(1') \quad w'[L_{m1}(1+r') + L_{m2}(1+r')^2 + \ldots + L_{mn}(1+r')^n] < w'L$$

Whatever may be the proportion of fixed and circulating capital or the durability of capital with which the machine is produced, the price of the machine will decrease relative to the wages paid to the workers after the rise of $w$. In fact the quantity of direct labour saved by the machine, which is the second member of equation (1), cannot be affected by the fall of $r$ as is the former. Even if the price of the machine rises in money terms and the machine is produced with more "labour-intensive" processes relative to corn itself, the conclusion remains the same. Thus the "Ricardo effect" is not due to the "curious effect", the rise of wages being the direct cause of them both.

Ricardo did not deal with the case of the machine employed in the production of wage-goods. According to his theory this case would be of

course the only one in which the employment of the machine causes a variation in the rate of profit.

It is possible to prove that, if the machine were employed in producing wage-goods the rate of profit would end up at an intermediate level between the one prevailing before the rise in the wage-rate and the one which would have been fixed if the machine had not been employed [30].

Suppose that only a consumer commodity $A$ is produced. $L_{it}$ is the labour employed in period $t$ in the productive process in which the machine is used, while $L_{dt}$ is the labour employed in the process in which the machine is not used.

Let us suppose that the machine is used in a process of production which has already required labour in past periods of production. The total quantity of labour employed in the production of the commodity is lower in the process using the machine. But the machine is a means of production and a product of labour. Therefore the quantity of past labour required in the process employing the machine is higher than in the process in which it is not used.

Hence the following conditions must be stated:

$$\text{(I)} \qquad L_{d1} + L_{d2} + \ldots + L_{dn} > L_{i1} + L_{i2} + \ldots + L_{in}$$

the machine is a labour-saving one.

$$\text{(II)} \qquad L_{d1} > L_{i1}$$

the machine saves direct labour.

$$\text{(III)} \qquad L_{d2} + \ldots + L_{dn} < L_{i2} + \ldots + L_{in}$$

the quantities of past labour are higher when the machine is used.

$$\text{(IV)} \qquad L_{d2} \leq L_{i2}; \quad \ldots; \quad L_{dn} \leq L_{in}$$

As the machine saves only direct labour the quantity of labour employed in period $t$ ($t > 1$) can be higher or equal in process $i$ relative to process $d$. If $L_{dt} = L_{it}$ no labour is employed in the production of the machine in period $t$. The machine must first be produced before it is possible to employ it. Its process of production, however, can be either "labour-intensive" or "capital-intensive" relative to the process of production of commodity $A$.

[30] In the following pages I shall deal with changes in real wages, i.e. the "Neo-Ricardian case".

Let $a_i$ be the commodity wage-rate paid in the process involving the machine and $a_d$ the commodity wage-rate paid in the other process. The price of the consumer commodity will be

$$(2) \qquad a_d p_a [L_{d1}(1 + r) + L_{d2}(1 + r)^2 + \ldots + L_{dn}(1 + r)^n] = p_a$$

when the machine is not employed and

$$(2') \qquad a_i p_a [L_{i1}(1 + r) + L_{i2}(1 + r)^2 + \ldots + L_{in}(1 + t)^n] = p_a$$

when the machine is employed.

Let $DL_1$ be the quantity of living labour saved by the machine $(L_{d1} - L_{i1})$ and $DL_2$; ...; $DL_n$ the rise in quantities of past labour required by the process employing the machine $(L_{i2} - L_{d2}$; ...; $L_{in} - L_{dn})$. The following equation is satisfied by the positive rate of profit $r^*$:

$$(3) \qquad DL_1(1 + r) = DL_2(1 + r)^2 + \ldots + DL_n(1 + r)^n$$

Figure 1 shows how the capitalized terms of living and past labour change with the variations of the rate of profit. The past labour "value" curve is higher than the straight line representing the "value" of the living labour saved when $r > r^*$, intersects it at the profit rate $r^*$ and runs under it for $r < r^*$.

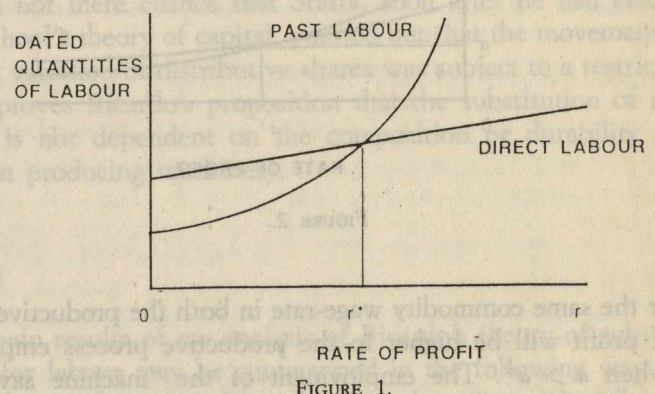


FIGURE 1.

The relationship between the commodity wage-rate and the rate of profit can be expressed by the following "Dmitrieff equations" [31].

[31] See DMITRIEFF (1977, p. 59 ff.). Dmitrieff pointed out the role of wage goods in determining the rate of profit.

$$(4) \qquad a_d = \frac{1}{L_{d1}(1+r) + L_{d2}(1+r)^2 + \ldots + L_{dn}(1+r)^n}$$

$$(4') \qquad a_i = \frac{1}{L_{i1}(1+r) + L_{i2}(1+r)^2 + \ldots + L_{in}(1+r)^n}$$

As regards the relationship between wage and profit we have:

$$a_i > a_d \qquad \text{for} \quad r < r^*$$
$$a_i < a_d \qquad \text{for} \quad r > r^*$$
$$a_i = a_d = a^* \quad \text{for} \quad r = r^*$$

Figure 2 shows the relationship between wage and profit in both the productive processes. $i$ is the curve representing the relationship in the process employing the machine; curve $d$ refers to the process in which the machine is not used.

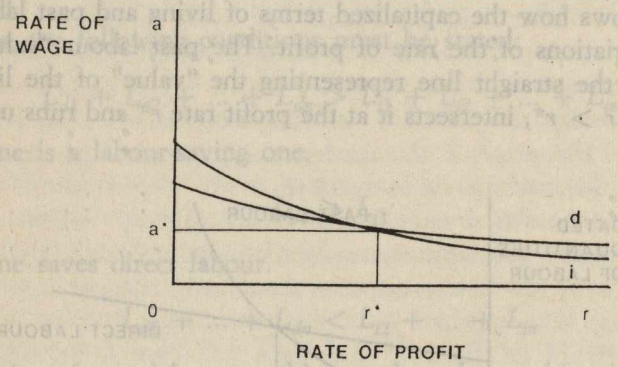


FIGURE 2.

Under the same commodity wage-rate in both the productive processes the rate of profit will be higher in the productive process employing the machine when $a > a^*$. The employment of the "machine saving direct labour" is profitable only if the wage-rate is higher than a given critical level.

Ricardo seems to deny the possibility of the so called "reswitching of techniques". In fact, the machine is employed for all the values of $r$ lower than $r^*$, so that systems with higher "capital intensity" seem to become profitable when the profit rate falls. The reswitching of techniques is the main argument used by "Neo-Ricardian" economists in their dispute with

Neo-Classical economics [32]. But Ricardo's analysis of the substitution of machinery for labour differs considerably from the Neo-Classical analysis of the substitution of capital for labour. Ricardo did not deal with a production function with "capital" as an homogeneous factor. He did not compare the "price of capital" with the "price of labour", but the price of a single machine with the price of the labour which it can substitute.

Moreover the "direct labour-saving machine" is both a labour-saving and a capital-saving one, because Ricardo regarded it as the product of less labour than it displaces, so that total wages *advanced* by capitalists are lower when it is employed [33].

The change of technique involved in the employment of the machine in Ricardo's analysis is devoid of "ambiguousness". The assumptions Ricardo made, synthesized by conditions (I)-(IV), exclude all the possibilities of a reswitching of techniques, because the machine is a product of labour that saves a given quantity of direct labour. Only if Ricardo's machine had been able to change the whole structure of the dated quantities of labour, would the reswitching of techniques have been possible.

The substitution of machinery for labour in Ricardo's analysis is also completely different from the Austrian School's theory of capital [34]. There is no need for the "average period of production" to which marginal productivity conditions are applied.

It was not mere chance that Sraffa, soon after he had criticized the Austrian School's theory of capital, pointed out that the movement of prices caused by a variation of distributive shares was subject to a restriction. This restriction proves Ricardo's proposition that the substitution of machinery for labour is not dependent on the composition or durability of capital employed in producing machinery.

## *Conclusions*

The main results of my analysis of Ricardo's theory of substitution of machinery for labour may be summarized in the following way:

1. the employment of "machines saving direct labour" is due to a

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[32] See, for example, GAREGNANI (1970, pp. 421-4).

[33] See BERG (1980, p. 59).

[34] Several authors asserted that Ricardo's theory of the substitution of machinery for labour was like the Austrian theory of capital. For example according to Wicksell in Ricardo's analysis, "the theories with which Böhm-Bawerk has recently enriched the subject lie enclosed as in the bud" (WICKSELL, 1954, p. 38).

rise in the difficulty of production of wage-goods which involves an increase in the "real value" of labour;

2. the assumptions clearly made by Ricardo exclude that "the Ricardo effect" is due to "the curious effect", because the machine is supposed to be produced in the same conditions as corn;

3. even in the "Neo-Ricardian case" the "Ricardo effect" does not depend on the "curious effect";

4. Sraffa's analysis of the relationship between price increases and wage increases proves the causality pattern stated by Ricardo;

5. Ricardo's analysis does not deal with the reswitching of techniques because the employment of the "machine saving direct labour" is a kind of change of technique which lacks "ambiguousness";

5. Ricardo's analysis needs no valuation of capital as a factor of production independent of the distribution of income, so it is therefore completely different from the Neo-Classical theory of substitution of capital for labour.

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## LA SOSTITUZIONE DEL LAVORO CON LE MACCHINE E "I DUE EFFETTI RICARDO"

Ricardo analizza la sostituzione delle macchine al lavoro come conseguenza della crescita del saggio di salario nella sezione V, capitolo I dei *Principles*. Questo processo economico è chiamato da Hayek l' "effetto Ricardo".

L'interpretazione prevalente dell' "effetto Ricardo" pone in relazione la sostituzione delle macchine al lavoro con la diminuzione dei prezzi relativi dei beni prodotti con un alto rapporto tra capitale fisso e circolante, causata dall'aumento del saggio di salario e dalla conseguente diminuzione del saggio di profitto. Questo mutamento nei prezzi relativi è chiamato da Ricardo il "curioso effetto". Si può però dimostrare che l' "effetto Ricardo" è indipendente dal "curioso effetto".

Qualunque sia la causa dell'aumento del saggio di salario (la coltivazione di terre meno fertili e il conseguente aumento del prezzo del grano, come nel caso esplicitamente analizzato da Ricardo, o un aumento del salario reale) il prezzo delle macchine risparmiatrici di lavoro vivo deve sempre diminuire relativamente al saggio di salario stesso. Diviene allora conveniente utilizzare le macchine nella

produzione. L'"effetto Ricardo" non richiede quindi alcuna particolare assunzione riguardante la combinazione di capitale fisso e circolante o la durata del capitale tanto nella produzione dei beni salario che nella produzione delle macchine.

Sraffa, in *Produzione di merci a mezzo di merci*, dimostra implicitamente la validità dell'analisi ricardiana. Perciò la sostituzione delle macchine al lavoro nell'economista classico è differente dalla teoria neoclassica della sostituzione del capitale al lavoro.

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# PROFITABLE DESTABILIZING SPECULATION
## A Survey With Some Modern Uncertainty Theory Insights

by
MICHAEL A.S. GUTH *

In the mid-1950s economists began debating the merits of flexible exchange rates and the stability of a flexible regime as compared with exchange rates pegged to the gold standard. One of the main concerns of this debate focused on whether speculators would destabilize markets. In defense of free market operation, Milton Friedman advanced the notion that speculators profit from buying low and selling high, and thus tend to stabilize market prices. An extensive literature then grew out of the question of whether profit-earning speculators could destabilize markets.

The potential for profitable destabilizing speculation extends far beyond foreign exchange regimes and impacts virtually all microeconomic and macroeconomic market theory. For if destabilizing speculators always lose money, then in a Darwinian sense they will fail to survive. However, if speculators may destabilize markets while they earn their profits, then destabilizing speculation may be expected to persist over time.

The present state of knowledge about the relation between speculative profits and stability evolved from studies in international economics, price theory, and uncertainty theory. From a macroeconomic perspective, profitable destabilizing speculation represents a (sustainable) endogenous contribution to business cycles. And thus by examining the speculative motive and its impact on price dynamics, we may shed further light on the microfoundations of macroeconomics *under uncertainty*. Indeed many post-Keynesian proponents of active fiscal policies point out the need to counteract just this sort of endogenous market instability.

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This article proceeds as follows. In Section 1 we state the basic proposition under consideration and review the criteria necessary to disprove the proposition. In Section 2 we look at a series of general counter-examples that are perhaps best suited to a stock market or other predominantly speculative environment. Section 3 then focuses upon international economics, the setting where this literature began. Section 3 contains some proposed counter-examples that rely upon unique institutions in foreign exchange markets, a survey of the literature's empirical work, and some general observations about exchange rate stability by forecasters. In Section 4 we consider what economic theorists have learned from the Arrow-Debreu contingent claims economy approach, and we attempt to resolve some semantic differences over the definition of speculation and stability via modern uncertainty theory. Section 5 contains our conclusions from this study, a list of issues still unresolved, and some suggestions for future research.

## 1. *Speculation and Stability: The Friedman Proposition*

The argument that profit-earning speculators stabilize markets dates back to the Nineteenth Century, e.g., John Stuart Mill advanced the notion in his *Principles of Political Economy* [1]. In the 1950s, Milton Friedman's contention that profitable speculation tends to stabilize a market shook the conventional wisdom [2] blaming speculators for exchange rate instabilities during the 1920s and Great Depression era. In support of flexible exchange regimes and a general free market philosophy, Friedman (1953, at p. 175) asserted speculation can generally be destabilizing only if speculators on average sell at a low price and buy at a high price.

In a subsequent work, Friedman (1969) restated the criteria necessary to disprove his conjecture.

> "Consider any market in operation. Suppose that an additional set of transactions are made in that market by an additional group of people whom we shall call 'speculators' or 'new speculators'. We shall then deal only with the question whether this additional set of transactions increases the fluctuations in price ... By dealing this way with a change in the amount of speculation, we can avoid the troublesome intellectual problem of defining zero speculation without any loss in generality. We shall make one further assumption ... that the activities of speculators do not affect the quantities demanded and supplied by other participants in the market at each current price" (Friedman, 1969, pp. 286-287).

[1] See MILL (reprinted 1921, pp. 707-708).

[2] See, e.g., DULLES (1929).

Friedman's latter criteria about the "other market participants" has proven to be the most controversial in the literature. Krueger (1969) found Friedman's assumption of independence from speculative activity to be implausible and therefore limiting the scope of the Friedman Proposition.

Indeed in most financial markets, traders must consider the actions and purchasing tendencies of all market participants – including speculators – to assess the capital gains potential of an asset. The prevailing price of an asset already gives the market's best estimate for its value. An individual purchasing the asset must therefore believe not only that its return will be better than average, but that its return will be better than the market's best estimate as reflected in the prevailing price.

However, if we consider markets where speculative purchases constitute only a small percentage of trading volume, then Friedman's independence criteria is still manageable [3].

## 2. *General Counter-Examples*

William Baumol (1957) presented a series of famous counter-examples based on a cyclical time path for prices. Baumol intuitively argued that if speculators purchase on the upswing and sell on the downswing of the cycle, they will increase the frequency and, under some exogenously specified conditions, the amplitude of the fluctuations.

The chief criticisms of Baumol's counter-examples, voiced by Telser (1959 and 1981) and Friedman (1969, p. 287n), focused on two points in Baumol's technical presentation. First, it was argued that Baumol's nonspeculative excess demand depended on past prices and therefore the speculators' purchases as well: Baumol's "nonspeculators" allegedly speculated. To see this technical point, note that the sinusoidal curve

$$P_t = A \cos qt + B \sin qt + C \tag{1}$$

is equivalent to

$$P_t = DP_{t-1} - P_{t-2} + E. \tag{2}$$

Baumol wanted to develop a model in which "nonspeculative" demand could generate this sinusoidal price path and then study the role of speculative purchases on the upswing and sales on the downswing. This underlying excess demand took the form

[3] Lipschitz and Otani (1977) at page 38 support this view as well.

$$N_t = WE - W P_t + WD P_{t-1} - W P_{t-2}, \qquad (3)$$

with constant $K$ and positive constant $W$. Current price and recent price trends are shown in the right-hand side of (3).

The second criticism of Baumol's models was that his third counter-example showed a speculative bubble as a destabilizing influence but did not require the speculative profits to be realized, which would burst the bubble. Baumol (1959) himself conceded that his third counter-example failed to illustrate *profitable* destabilizing speculation – which by definition would require these profits to be realized.

However, Baumol maintained his first two models had demonstrated profitable destabilizing speculation, even if price trends influenced the underlying demand in them. More important, Baumol noted that no one had disproved the central idea of buying on an upswing and selling on a downswing [4].

We propose to resolve this dispute as follows. Baumol's counter-examples reveal profitable destabilizing speculation in an economic environment where one group of speculators profit at the expense of another group of speculators, who may in fact comprise the rest of the market. This environment corresponds to the New York Stock Exchange, the Chicago Board of Options, the gold market, and the American dollar exchange, among others. Moreover, Kemp (1963) suggested Baumol's speculative bubble counter-example be viewed as destabilizing speculation for a limited time interval and profitable for the few speculators who can take their profits before the bubble collapses.

In short, the counter-examples reviewed in this section appear more suited to economic environments predominantly characterized by speculative transactions. In the section that follows, we discuss proposed counter-examples based on institutional features of the foreign exchange markets. While we have shown Friedman's Proposition will not strictly hold in a predominantly speculative market, it will be of some interest to examine whether the Proposition applies to foreign exchange markets which more closely approximate Friedman's restated criteria for the independence of other market participants' demand and supply decisions from speculative activities.

[4] The literature has more frequently emphasized Baumol's concession than his defense of this general theme of buying on the upswing and selling on the downswing. Compare LOGUE (1975), GLAHE (1966), KRUEGER (1969), FARREL (1966), JOHNSON (1976), and TELSER (1981); with KEMP (1963), BAUMOL (1965, pp. 17-31), and EICHENGREEN (1982).

3. *International Economics*

A. *Theoretical Counter-Examples.* – Stein (1961) proposed a counter-example in which reaction to speculative purchases by the government results in a destabilizing influence. Suppose an exchange authority purchases some speculators' foreign exchange supply. After acquiring the foreign exchange, the authority becomes panicked over its depleted home currency reserves and devalues it. Following the devaluation, the speculators buy back the home currency at a profit; the speculators apparently profited at the expense of exchange rate stability. While this example helps illustrate some of the unintended consequences of government intervention in the foreign exchange market, it does not refute the Friedman Proposition. In Stein's article the government's reaction to the speculative sales, rather than the speculators themselves, creates the opportunity for profits and destabilizes the exchange rates. Stein illustrated how profit-earning speculators may cause government policies to be reshaped in such a way as to destabilize markets more than if the government did not intervene [5].

Williamson (1972) suggested a second counter-example based on traders' lagged responses to exchange rate changes, the so-called "*J*-curve" reaction. A country's currency appreciation would in the short run raise the value of that country's exports; while in the long run, decreased foreign demand for that country's goods and services would actually reduce its net trade balance.

Suppose a country's period 0 exchange rate rests in equilibrium at $r_e$. In period 1 a group of speculators begins selling, for whatever reason, domestic currency. The speculative transactions lower the exchange rate to $r_0 < r_e$ and induce a balance of payments deficit. Since the trading countries have relatively inelastic short-run demand for that country's goods and services, they will attempt to purchase the same quantity of goods and services at the new high exchange rate prices. Thus the foreign nations have to supply additional units of foreign currency to purchase these goods, which tends to depress the value of their own currencies. Due to the short-run demand inelasticity, the additional supply of foreign currency may reduce the initial country's exchange rate further.

In period 2, Williamson's clever speculators realize that long-term forces will eventually raise the country's exchange rate again. When the exchange rate drops to $r_0$, Williamson's speculators begin buying up the

[5] In private correspondence, Professor Friedman has informed me that, in retrospect, he perhaps envisioned such circumstances when he included the qualifier, "in general", in the Friedman Proposition.

domestic currency's commercial excess supply. The long-term forces combine with the speculators' purchases to raise the exchange rate to $r_2 > r_e$.

If Williamson's proposed speculative behavior recurs, the exchange rate will oscillate about its equilibrium moving from $r_0$ to $r_2$. Speculators earn positive profits – buying low at $r_0$ and selling high at $r_2$ – yet their actions destabilize the exchange rate. Williamson's speculators exploit profits from traders who determined their volume exports and imports for nonspeculative reasons, based on advanced legal contracts to trade, or based on commitments from experience with the equilibrium rate of $r_e$.

As Price and Wood (1974) note, the general profit-making opportunity relies on a dichotomy in forecasting ability or intelligence among the profit-earning speculators and the other market participants. These other traders cannot forecast when long-term influences will affect the exchange rates as well as Williamson's speculative group. Levin (1983) extended Williamson's model to a rational expectations framework and obtained results indicating that unanticipated real disturbances can lead to overshooting. Furthermore, Levin found that capital immobility may lead to exchange rate fluctuations around long run equilibrium values as the exchange rates lag behind changes in the balance of trade.

Further work on the rational expectations theme by Canzoneri (1984) has showed that even for unpegged exchange rates, if a speculator expects 'other market participants' to react to gold price fluctuations, then he too will consider the fluctuations in deciding his demand and supply quantities. When enough speculators behave this way, then gold price changes will indeed partially determine the prevailing exchange rates, thus fulfilling the speculators' destabilizing beliefs.

Under the "new" macroeconomic approach, Canzoneri's policy prescription occasionally may run counter to the present interventionist philosophy of leaning against the wind.

> "If the exchange rate rises above its long run equilibrium value it must be forced down; an appreciation must be engineered. 'Rational' portfolio managers will foresee this appreciation and raise their demand for money; the (real) supply of money must be increased to accomodate this new demand. Put another way, the monetary authority must accomodate the demand for money that is consistent with the expected appreciation of depreciation that moves the exchange rate in the desired direction" (Canzoneri, 1984, p. 76).

The correct policy may sometimes call for accommodation: a currency depreciation should be met with an increase in the money supply.

We conclude from the work of Williamson (1972) and Price and

Wood (1974) that institutional constraints in the foreign exchange markets can permit profitable destabilizing speculation. Speculators in these works take an exchange rate out of equilibrium by selling their carry-over stock, and then later buy back when the exchange rate has fallen still farther. Their actions cause the exchange rate to oscillate around its long run equilibrium value while the speculators earn profits. Moreover, Canzoneri (1984) has shown how if enough speculators believe foreign exchange rates depend on movements in gold prices, then even in a flexible regime, exchange rates may be further destabilized by fluctuations in the price of gold.

B. *Empirical Findings.* – Although one might have expected the empirical tests of Friedman's Proposition to employ data on stock market speculation, the empirical work in this area has primarily used exchange rate data. The empirical tests have yielded inconclusive results. Representative works on both sides of the Proposition include Arndt (1968) and Kenen (1975).

Arndt's study indicated that speculators in his sample from the Canadian foreign exchange probably follow the logic in Friedman's Proposition. Arndt concludes, "In a stable environment ... our theory predicts – and the data tentatively support this conclusion – that speculators' expectations will be a slowly changing variable with considerable inertia, and that speculative sales and purchases will have a dampening effect on movements in the exchange rate" (Arndt, 1968, p. 69).

On a more ambiguous note, Kenen (1975), in examining speculation under different exchange rate regimes, found no uniform data to support the conclusion that profit-earning speculators generally stabilize prices. "Although long lags and high elasticities appear to amplify instability, we cannot conclude from (its profitability) that speculation is indeed stabilizing" (Kenen, 1975, p. 134).

The empirical work as a whole – as might be expected from the difficulty in assessing theoretically nonspeculative and speculative purchases – has not provided conclusive evidence one way or the other for the validity of the Friedman Proposition. Moreover, one senses a reluctance among the econometricians who examined this relationship between speculation and stability to categorize professional (and presumably profitable) speculation as a stabilizing influence.

C. *General Comments on Foreign Exchange Rate Stability.* – In the opening paragraphs of this work we pointed out that speculation must be profitable over time, or the losses from speculative activity would be a self-correcting problem: these speculators would fail to survive in a Darwin-

ian sense. It is of some interest then to examine how speculation has generally been perceived to influence the stability of foreign exchange markets. The prevalent view among exchange rate forecasters seems to have initially hoped speculation would help dampen exchange rate fluctuations, and then subsequently shifted to viewing speculation – at least on exchange markets – as part of the inherent randomness of the market.

In the early 1970s when countries first adopted flexible exchange regimes, the initial market instability that ensued was thought to be "what one might expect during a learning period, when speculators' views regarding long-run equilibrium values are weakly held and substantial stimulus is therefore required to make them act on them" (Whitman, 1975, p. 138).

After many years experience with flexible regimes, the prevalent view shifted to some disillusionment, in light of the earlier enthusiasm for the unpegged regime, that the exchange rate may have inherent instabilities spawned by professional speculation.

> "The focus of attention then shifted to market imperfections, including insufficiency of stabilizing speculation, as the cause of the volatility that characterized real world exchange rates. But, with the passage of time, an explanation of these imperfections as temporary phenomena characteristic of a transition period became less and less credible" (Whitman, 1984, p. 300).

Economists have thus recognized that professional (profit-earning) speculation does not equate with a stabilizing influence in foreign exchange markets, and at least some have pointed to this same speculation as a destabilizing influence.

## 4. *Modern Uncertainty Theory*

For the modern reader, the literature on profitable destabilizing speculation as a whole appears confusing and contradictory. Many of the early works in the 1950s and 1960s employed models which simply failed to come to grips adequately with a complex phenomenon like speculation. For example, speculation can only occur under uncertainty; yet many of the early works in the literature posed models with no random variables generating uncertainty. In a world of certainty, purchases for resale value illustrate *arbitrage* not speculation.

Speculation theorists now employ some version of the general equilibrium contingent claims model to solve comparative statics issues via standard economic reasoning. The standard format provides individuals with production functions, preferences, time-distributed endowments, etc., and

specifies the available market range. Economists then pose comparative statics questions, e.g., what happens if preferences change?

Hirshleifer (1975, 1976) introduced the contingent claims model of speculation, in which investors buy futures contracts knowing that they will have the opportunity to revise their futures positions after new information arrives and before the state of the world is revealed. Hirshleifer's main theme contends that differences in attitudes towards risk do not explain why people speculate, a la the Keynes-Hicks tradition. Rather Hirshleifer noted differing beliefs, risk preference, demand elasticities, market regime, and other parameters jointly determine the incidence of speculation.

Much of the profitable destabilizing speculation literature argued over semantics: how to define a "nonspeculator" [6], how to measure "stability". Analysis of the Arrow-Debreu contingent claims economy can eliminate much of this semantic controversy. First, we will clarify the relation between market range and nonspeculators and then focus on proposed measures for stability – some of which are still relevant for today's models [7].

A. *Speculation Defined by Scope of Markets.* – Commenting on Hirshleifer's article, Feiger (1976) noted that with complete contingent claims markets, no one has any desire to speculate. With incomplete markets, everyone will form contracts with the intent of revising them [8]. However, Hirshleifer and Feiger left this point somewhat vague.

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[6] KALDOR (1939) distinguished speculative sales or purchases by perceived capital gains as the *sole* motive for transactions. Friedman suggested "perhaps a nonspeculator can only safely be defined (if this is done in terms of his demand curve) as one whose purchases are directly influenced by current prices but not by past prices or price trends" (as quoted in BAUMOL, 1957, p. 269). TELSER (1959) defended Friedman's notion and added that nonspeculators derive "profits from other sources". BAUMOL (1959) defined nonspeculators as people who desire to hedge to avoid price speculation.

[7] For fluctuating prices, stability can be defined in terms of the frequency, volatility, or variance of these fluctuations. In the Arrow-Debreu economy, uncertainty enters via the random variable determining the state of the world. Therefore, stability would have a natural definition in the contingent claims economy as reducing the variance of this random variable. OBST (1967) defined stability by deviations from a trend line, rather than the mean of a sample.

[8] "Where markets in contingent claims are not complete, all agents will speculate except in exceptional circumstances. This does not mean that everyone will be found trading gold futures. Rather, in a world of incomplete contingent markets, all agents possess endowed assets (such as health and ability to work), which cannot be completely traded away at some initial time. Therefore, they will be forced to make initial commitments that will be revised after nature has determined the random event that occurs (such as the state of their health)" (FEIGER, 1976, p. 677).

Despite the widespread recognition among economic theorists that the scope of markets determines the need for speculation, we are not aware of any work that rigorously proves this point. We therefore will develop our own model of speculation to illustrate the relation to incomplete markets.

Consider an exchange economy with riskless good $N$, risky good $Z$, and states of the world $A$ and $B$. All individuals receive the same endowment for good $N$, but endowments for good $Z$ differ: $N_A \equiv N \equiv N_B$ and $Z_A \neq Z_B$.

*Definition 1*: A *Fully Complete Market* contains separate contingent claims for $N_A$, $N_B$, $Z_A$, and $Z_B$.

A fully complete regime only requires enough contingent claims to span the space of potential consumption vectors; separate state-commodity contracts shown in Definition 1 are sufficient but not necessary.

*Definition 2*: An *Unconditional Market* contains claims to $N$ and $\zeta$, where $\zeta$ represent a 1 : 1 entitlement package of $Z_A : Z_B$.

The unconditional market regime corresponds to a claim for a numeraire, such as money, and a stock market security that entitles the purchaser of $\zeta$ to one share of $Z$ for every possible state of the world.

In a *non-informed environment* individuals would purchase contingent claims in an initial period, and then when the state of the world is revealed the claims would payoff accordingly. In an *informed environment*, following the definition proposed by Hirshleifer (1975), the individuals buy contingent claims in period 0 knowing that they will have the opportunity to retrade in period 1 when information about the state of the world is disseminated. Finally the state of the world is revealed in period 2, and all contingent claims as of period 1 payoff accordingly.

*Definition 3*: *Speculation* occurs in any market regime when individuals trade to intermediate consumption bundles in an informed environment that differs from their one-shot consumption bundle in a non-informed situation.

*Lemma 1*: A (rational) utility-maximizing individual will generally speculate in an incomplete market regime.

*Proof*: This proof employs the Unconditional Market regime; however, we discuss how to generalize it to other regimes at the proof's conclusion.

*The Noninformed Environment.* – Let some individual assign probability $\rho$ to state A occurring and $(1 - \rho)$ to state $B$. The individual receives the same endowment for the riskless asset $N$ in either state; moreover, the individual cannot trade claims for $N$ conditioned on each state of the world so that $N_A = N_B = N$. The individual maximizes expected utility

$$\underset{N, Z_A, Z_B, \zeta}{\text{MAX}} \; \rho \, U(N, Z_A) + (1 - \rho) \, U(N, Z_B)$$

subject to the budget constraints

$$N = N^e - P_\zeta \zeta, \qquad Z_a = Z_a^e + \zeta, \qquad Z_b = Z_b^e + \zeta.$$

where $P_\zeta \equiv P_z$ represents the 1 : 1 sandwich price for $Z_a$, $Z_b$, and the $e$ superscripts denote the individual's endowment.

Let $U_{Z_a} = \dfrac{\partial U(N, Z_a)}{\partial Z_a}$, $U_{Z_b} = \dfrac{\partial U(N, Z_b)}{\partial Z_b}$, $U_N = \dfrac{\partial U}{\partial N}$. Feasibility in the pure exchange economy requires $\Sigma N = \Sigma N^e$ and $\Sigma \zeta = 0$. The optimality conditions emerging from this expected utility maximizing problem reduce to

$$\rho \frac{U_{Z_a}}{U_N} + (1 - \rho) \frac{U_{Z_e}}{U_N} = P_\zeta \equiv P_Z.$$

Because $U_{NZ} = 0$ by the zero complementarity assumption, the individual's marginal rate of substitution for $N$ across states will equal unity:

$$\frac{U_{N_a}}{U_{N_b}} = 1. \tag{3.1}$$

*The Informed Environment.* – If this individual knew he could revise his trading position after new information emerged, would he choose a different claim bundle? In general, yes. The individual now trades first to an intermediate contingent claim bundle, denoted with superscript $t$. Suppose at period 1 conclusive information as to which state will occur emerges. The contingent claim market then reopens, and the individual then retrades from his intermediate position to his final period 2 consumptive optimum. However, the new information's revelation will collapse the 1 : 1 sandwich to simply a contingent claim for $Z$.

Thus the individual now maximizes expected utility

$$\underset{N^t, Z_a^t, Z_b^t, N', N'', Z_a', Z_b''}{\text{MAX}} \; \rho U(N', Z_a') + (1 - \rho) \, U(N'', Z_b'')$$

subject to budget constraints

$$N' + P_{za}' Z_a' = N^t + P_\zeta' Z_a^t, \tag{3.2}$$

$$N'' + P_{zb}'' Z_b'' = N^t + P_\zeta'' Z_b^t, \tag{3.3}$$

$$N^t + P_{za}^0 Z_a^t + P_{zb}^0 Z_b^t = N^e + P_{za}^0 Z_a^e + P_{zb}^0 Z_b^e. \tag{3.4}$$

$P^0_{za}$ and $P^0_{zb}$ represent the implicit prices for good $Z$ in states $A$ and $B$, had such claims existed. In particular, since $\zeta$ represents a 1 : 1 package of $Z$, $P^0_\zeta = P^0_{za} + P^0_{zb}$. The primes denote the conditional prices and quantities that would prevail in each state: one prime denotes state $A$, two primes denote state $B$. Furthermore $P'_{za} \equiv P'_\zeta$, $P''_{zb} \equiv P''_\zeta$.

Let $\lambda_1$, $\lambda_2$, $\lambda_3$ denote the Lagrange multipliers associated with constraints (3.2), (3.3), and (3.4) respectively. Then the individual's marginal rate of substitution across states is

$$\frac{U_{N'}}{U_{N''}} = \frac{\lambda_1}{\lambda_2}\frac{1-\rho}{\rho}. \tag{3.5}$$

Comparing expressions (3.5) and (3.1), we see they equate only when

$$\frac{\lambda_1}{\lambda_2} \equiv \frac{\rho}{1-\rho} \tag{3.6}$$

Individuals whose shadow prices differ from the ratio defined in (3.6) will generally purchase contingent claim bundles in informed environments that differ from their one-shot bundle in the noninformed environment. (End of Proof)

REMARK 1: Transactions costs may also prohibit traders from buying and reselling in an incomplete market regime.

REMARK 2: With complementarity between the goods, expressions (3.1) and (3.5) would become functions of $N_a$, $N_b$, $Z_a$, and $Z_b$. The generalized proof would then show that the two functional relationships differ. If $\mu_2$ and $\mu_3$ denote the Lagrange multipliers associated with the latter two budget constraints in the noninformed maximization problem, then individuals will generally buy different contingent claim bundles unless $\frac{\mu_2}{\mu_3} = \frac{\lambda_1 P'_{za}}{\lambda_2 P''_{zb}}$.

## 5. *Conclusions and Future Research*

This article has reexamined the proposition that speculators buy low and sell high, and thus tend to stabilize market prices. Although this proposition dates back to the Nineteenth Century, the proposition was given new life in the 1950s when Milton Friedman used it to support the adoption of flexible exchange rates. However, Friedman was careful to restate the proposition in terms of "new speculators" and the reaction of "other market

participants" that left open the possibility of profitable destabilizing speculation in a less restrictive environment, such as the real world.

Baumol took up Friedman's challenge by proposing counter-examples that depict an early portrayal of the more recent phenomena of "overshooting". The jest of Baumol's counter-example is that (some fraction of speculators) can overshoot the trough and peak of a cycle, with the practical consequence that they buy on the upswing and sell on the downswing of the cycle.

Comments on the technical features of Baumol's model raised questions as to under what set of restrictions the Friedman Proposition would be valid. To summarize briefly, these criteria include minimal, if any, effect on other market participants by the speculative group under consideration. Baumol's work illustrates one group of speculators profiting at the expense of another speculative group, as can be witnessed in transactions in stock, futures, and foreign exchange markets.

The international exchange markets also have particular institutions that may yield theoretical possibilities for profitable destabilizing speculation: intervention by monetary authorities, "*J*-curve" time-delayed reactions, and overshooting. The empirical literature has found evidence of both stabilizing and destabilizing speculation without providing conclusive evidence of speculation which is simultaneously destabilizing and profitable. Indeed some of the initial optimism for flexible exchange regimes voiced by economic theorists and forecasters in the 1960s and early 1970s gave way to disillusionment in the wake of foreign exchange instabilities of the 1970s and 1980s.

Finally, modern uncertainty theory has clarified some of the semantic controversies over how to define a speculator and a "nonspeculator". Moreover, uncertainty and stability is analyzed in the Arrow-Debreu regime through the variance of prices across a random variable determining the state of the world. We have shown that a utility-maximizing individual will generally speculate in an incomplete market regime.

At present an open question remains as to the extent of speculation in a fully complete and perfect contingent claims regime. Most economic theorists would argue that in such a fully complete regime no speculation will take place because individuals can purchase claims in the prior market that completely span the space of possible outcomes. Yet the mere existence of complete markets may not be sufficient to eliminate speculation. After all, individuals may still wish to attempt to garner capital gains in a fully complete regime off other individuals who do not share their beliefs for the state of the world outcome.

The Great Crash in the New York Stock Exchange of October 19, 1987, has shown that endogenous influences can cause greater instabilities in the market than even external factors. Panic buying and selling can lead to further panic. If such speculative behavior were not on the whole unprofitable, then it would not be expected to recur. Those speculators who panic and lose capital would be part of a self-correcting problem; however, forecasts for increased future market price variance highlight again the importance of profitable destabilizing speculation.

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## SPECULAZIONE DESTABILIZZANTE VANTAGGIOSA

Questo articolo esamina la validità della tesi secondo cui gli speculatori fanno profitti comperando a basso prezzo e vendendo a prezzo elevato destabilizzando così il mercato soltanto quando perdono denaro. Il fatto che Friedman abbia fatto sua questa affermazione relativamente alla speculazione sui cambi ha provocato una vasta letteratura che ha proposto contro-esempi teorici di speculazione destabilizzante vantaggiosa. L'articolo analizza dapprima le equazioni dinamiche generali per tutti i mercati economici per discutere le influenze destabilizzatrici; analizza poi particolari aspetti istituzionali del mercato dei cambi a sostegno di questa tesi. Viene utilizzato un moderno approccio teorico di incertezza per chiarire alcune controversie semantiche su come definire gli « speculatori » e la « stabilità ». Si spiega poi perché ognuno speculerà tipicamente in un regime di mercato non del tutto completo.

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# LE OMBRE CINESI: MODELLI STOCASTICI PER L'ANALISI DEI COMPORTAMENTI DI IMPRESA IN AMBIENTE DI INCERTEZZA

di
ANDREA BRERO e MARIO S. CATALANI *

## 1. *Introduzione*

Nel contesto dell'economia dell'impresa i modelli stocastici sono stati usati nel passato per spiegare l'evoluzione della struttura dimensionale delle imprese; a seconda degli autori maggiore enfasi è stata posta nell'analisi i) dei processi di concentrazione, ii) dei processi di crescita delle imprese, iii) della natalità e mortalità e iv), più indirettamente, nella verifica di proposizioni della teoria dell'impresa attinenti alla forma delle curve dei costi [1].

Il punto di partenza comune per tutti questi modelli è una regolarità osservabile nelle distribuzioni empiriche delle dimensioni delle imprese misurate con differenti modalità: esse sono distribuzioni altamente asimmetriche. Poiché la stessa forma della distribuzione è riscontrabile anche in altri fenomeni tra loro profondamente differenti ed è per di più generata come distribuzione limite da alcuni ben noti processi stocastici è sembrato naturale tentare di spiegare la realtà osservata come generata da alcune classi di processi stocastici. Il più agevole modello probabilistico con queste caratteristiche è quello noto col nome di processo di Markov, o processo autoregressivo di primo ordine: in termini economici si traduce nell'assumere che i saggi di crescita delle dimensioni sono indipendenti dalle dimensioni in preceden-

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[1] Si veda HART & PRAIS (1956) con particolare riferimento a i); KALECKJI (1945), IJIRI & SIMON (1977), SINGH & WHITTINGTON (1975) e STEINDL (1965) per ii) e iii); DAVIES & LYONS (1982) e ancora SIMON & BONINI (1958) per iv).

za raggiunte. Questa assunzione è anche nota sotto il nome di legge di Gibrat dell'effetto proporzionale. Effetti sistematici delle variabili poste al centro dell'analisi possono poi essere incorporati in questi modelli stocastici con ragionevoli assunzioni ad hoc. Questo aumenta la verosimiglianza dei modelli e le possibilità di test con dati campionari. I modelli analizzati sono così modelli stocastici che producono in stato di equilibrio stazionario le distribuzioni osservate (o distribuzioni piuttosto simili).

Una critica è stata sollevata nei confronti dell'approccio dominante in questa letteratura: i modelli probabilistici usati sarebbero analiticamente convenienti ma non riuscirebbero a includere i molti fattori agenti nella realtà (si veda ad es. Mansfield 1962, pp. 1035 e 1040), troppo peso verrebbe così dato alle leggi della casualità e troppo poco verrebbero valutati i fattori specifici che secondo le teorie economiche influenzano le variabili di volta in volta considerate. Accettando questo tipo di critica Shorrocks (1975) spiegò questo atteggiamento con la preoccupazione di generare stati stazionari di equilibrio stocastico: « l'introduzione di ogni specifico contenuto economico richiede che i parametri siano funzione delle variabili economiche e questo è incompatibile con le assunzioni di costanza dei parametri nel tempo ». Sempre secondo questo autore incorporare le proposizioni della teoria economica in questi modelli risulterebbe probabilmente nella perdita delle proprietà di convergenza a uno stato di equilibrio stabile delle distribuzioni. Shorrocks propone di conseguenza un modello quasi-stocastico con parametri che dipendono da variabili esogene.

In una sottoclasse del modello che proporremo nelle pagine seguenti si può mostrare la convergenza di processi di Markov con parametri che variano nel tempo (vedi pp. 546-550), ma non è esattamente necessario porre al centro della ricerca le proprietà di convergenza ad uno stato di equilibrio stazionario. Newman e Wolfe (1961) proposero un modello dove la matrice dei coefficienti di transizione delle imprese da una dimensione ad un'altra è funzione di variabili economiche (i prezzi dei prodotti). Nel loro modello gli elementi della matrice sono le frequenze osservate delle imprese che si muovono da una dimensione all'altra mentre nei modelli stocastici si tratta di probabilità di transizione [2].

[2] Per questa ragione anch'essi definiscono quasi stocastico il loro modello: i coefficienti diventano variabili deterministiche ma questo non altera le proprietà matematiche della matrice dei coefficienti. La matrice è (come si è detto) una funzione dei prezzi dei prodotti. Date certe assunzioni che fanno questa funzione monotona crescente e continua, sfruttando le proprietà dei processi markoviani, è definito, dati i prezzi, un equilibrio dell'industria: a ciascun prezzo corrisponde per $n$ che tende all'infinito un differente output d'equilibrio; il luogo di tali punti (coppie di prezzi e output) è la curva d'offerta dell'industria.

Il variare dei prezzi non permette a nessuna delle matrici dei coefficienti di transizione di

Newman e Wolfe vollero mostrare che l'output dell'industria può essere costante (l'industria in equilibrio Marshalliano di lungo periodo) senza che le imprese che lo compongono siano esse stesse in equilibrio. Più in generale il loro approccio sembra aprire la strada a una analisi per mezzo di modelli stocastici dei processi competitivi e dei loro effetti di modificazione della struttura delle industrie. Newman e Wolfe basarono la loro analisi su condizioni di concorrenza perfetta e lasciarono così fuori del loro campo di ricerca la differenza tra capacità di produzione e produzione effettiva e il ruolo che può avere l'utilizzo di capacità nelle configurazioni d'equilibrio.

Nello schema di ragionamento che proponiamo l'utilizzo di capacità assolve un ruolo assai simile a quello che i prezzi svolgono nel modello di Newman e Wolfe. Il processo stocastico che sta alla base del nostro modello è ancora una catena di Markov: un insieme di variabili economiche interagiscono nel determinare le probabilità di transizione che quindi non risultano costanti nel tempo. Analogamente a Newman e Wolfe abbiamo cercato di definire sotto quali condizioni si verifica una condizione di equilibrio stocastico nello stato delle variabili caratterizzanti l'aggregato di imprese, ma abbiamo effettuato i nostri esperimenti in un contesto dove un insieme di variabili economiche sono endogene al modello e conseguentemente lo spazio degli stati è multidimensionale. È questa una differenza sia rispetto ai modelli stocastici classici delle dimensioni d'impresa che rispetto a Newman e Wolfe dove i prezzi riflettono l'influenza delle variabili economiche ma lo spazio degli stati che caratterizza il modello è ancora unidimensionale.

Le nostre imprese operano in un mercato che possiamo definire di concorrenza imperfetta e applicano regole decisionali che sono modificate da eventi casuali e dai tentativi di adeguamento alle informazioni che diventano via via accessibili. La regola di comportamento generica delle imprese è la ricerca di un grado di utilizzo di capacità soddisfacente. Una variante considerata dipende da una funzione dei profitti, ma non abbiamo mai considerato un modello di comportamento ottimizzante, vincolato o meno all'ipotesi classica di massimizzazione dei profitti. Abbiamo seguito in questo le indicazioni che provengono da quasi tutta la letteratura che discute i modelli stocastici della dimensione delle imprese. Gli autori che hanno contribuito a questa letteratura, sia che abbiano sottolineato la compatibilità dei loro modelli con la teoria economica classica o abbiano invece rilevato come

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generare la distribuzione limite delle dimensioni di impresa ma, avvicinandosi al punto di equilibrio di offerta e domanda (qui ipotizzata esogena), la matrice dei coefficienti sarà sottoposta a cambiamenti « minimi »: il processo markoviano diventa « quasi omogeneo » e il modello permette previsioni abbastanza stringenti sulle distribuzioni osservate (almeno per industrie che possono essere considerate in equilibrio).

fossero più pertinenti a questo approccio le teorie dello sviluppo e della crescita piuttosto che la teoria ortodossa dell'impresa, hanno ottenuto in larga misura i loro risultati analitici senza incorporare la teoria del comportamento massimizzante all'interno del modello.

Quanto detto negli ultimi due paragrafi imparenta la nostra proposta ai modelli elaborati da Nelson e Winter (1982) nel quadro della loro teoria evoluzionistica dei comportamenti di impresa e, in particolare ai modelli che essi definiscono di statica comparata [3].

Nel nostro modello le scelte di investimento coincidono con la scelta della dimensione produttiva. Questa ipotesi non viene mai rimossa nel corso dell'analisi. Non c'è quindi nel modello alcun meccanismo di innovazione e di diffusione delle innovazioni anche se la sua struttura può prestarsi all'introduzione di ipotesi di ricerca stocastica delle innovazioni e di diffusione delle stesse ancora sulla falsariga dei modelli di Nelson e Winter.

Il nostro modello è caratterizzato da una terna di stati: utilizzo di capacità, scelte di investimento, dimensioni produttive. Il modello è essenzialmente un processo stocastico a tempo discreto strutturato ricorsivamente tramite equazioni alle differenze finite.

Le regole di comportamento delle imprese e le caratteristiche dell'ambiente in cui le imprese operano sono definite secondo assunzioni piuttosto rigide ma minime. Il mercato dei prodotti è soggetto a continue variazioni delle quantità domandate [4]. Dal lato dell'offerta vi sono rigidità nell'uso dei

[3] Il principale interesse di NELSON e WINTER (1982, pp. 36-38) è nell'analisi dei fenomeni del cambiamento strutturale nelle industrie e l'attenzione maggiore è posta sui processi di trasformazione delle regole decisionali delle imprese al mutare dell'ambiente economico circostante (includendo in ciò il cambiamento tecnico dei processi produttivi). Il loro obiettivo dichiarato è di modellare i processi dinamici di concorrenza Schumpeteriana, ma essi propongono anche modelli che definiscono statici e di statistica comparata.

I modelli statici sono usati più come strumenti critici nei confronti dell'analisi economica ortodossa (almeno « dell'ortodossia dei libri di testo », per usare le loro parole) e per sottolineare le differenze tra un approccio « ortodosso » e uno « evoluzionista », che per ottenere risultati positivi. In questo modo NELSON e WINTER (1982, p. 139) definiscono le caratteristiche formali degli equilibri evoluzionistici comparativamente alle caratteristiche degli equilibri ortodossi.

I modelli di statica comparata (reazioni delle imprese e dell'industria a cambiamenti delle condizioni dei mercati) sono un'introduzione all'esplicita trattazione dei problemi dinamici della crescita e della competizione in un contesto di cambiamenti tecnologici, così come nella teoria ortodossa attraverso il confronto tra situazioni di equilibrio si vogliono modellare i comportamenti delle imprese e delle industrie.

[4] Negli esperimenti effettuati è implicita una moderata espansione della domanda aggregata.

Recentemente MARRIS (1986) ha elaborato un modello (studiato con tecniche di simulazione) di imprese industriali che presenta analogie con il nostro ma predilige lo studio della

fattori produttivi che danno alle scelte produttive un carattere dicotomico e di irreversibilità.

Le imprese fronteggiano una domanda stocastica, tale che le quantità di domanda prevista per i propri prodotti possono divergere anche radicalmente dalle quantità effettivamente realizzate. Le scelte di investimento avvengono così in un ambiente incerto. L'esito delle scelte di investimento si riflette sul grado di utilizzo di capacità: una differenza positiva tra domanda prevista e domanda realizzata definisce un basso grado di utilizzo di capacità, l'inverso un alto grado di utilizzo. Un eccesso di capacità superiore alla norma ha un'influenza deprimente sulla propensione all'investimento, un elevato grado dell'utilizzo di capacità tende ad elevare le probabilità di investimento.

Il piano dell'articolo è il seguente. Nella prima parte presentiamo un modello particolarmente semplificato in cui compaiono come uniche variabili « primitive » l'utilizzo di capacità produttiva ($U$), gli investimenti ($I$), la domanda di prodotti dell'impresa ($D$). Questa semplificazione permette di mettere in risalto un punto che ci ha guidato nel lavoro: strutturare il fenomeno in esame come un processo stocastico multidimensionale.

Nella seconda parte tentiamo di arricchire le ipotesi base del primo modello con l'introduzione di nuove variabili. Qui l'apparato analitico-probabilistico avrà minor peso e si farà invece ricorso alle tecniche di simulazione.

## 2.1 *Descrizione del modello I*

Si consideri una variabile casuale $U$ (utilizzo di capacità produttiva), discreta, che assume i valori 0, 1, 2, 3, 4 (minimo utilizzo = 0, massimo utilizzo = 4). Ad ogni classe corrisponde una probabilità di investimento. Effettuata la decisione circa l'investimento, l'impresa « subisce » una domanda $D$ che è casuale.

Sia $I$ la variabile casuale dicotomica denotante la decisione o meno di investire: allora $I = (1, 0)$.

Conseguentemente alla realizzazione di $D$ si determina un nuovo utilizzo e così via.

È utile modellare quanto detto come un processo stocastico

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dinamica macroeconomica. Noi invece abbiamo voluto focalizzare la nostra attenzione su alcune caratteristiche microeconomiche e abbiamo coscientemente evitato di introdurre elementi macroeconomici con inadeguate soluzioni ad hoc. In effetti pensiamo che il nostro modello possa essere usato in un frammento di analisi macroeconomica con assunzioni e tecniche di lavoro analoghe a quelle proposte da Robin Marris.

$$U(1),\ I(1),\ D(2),\ U(2),\ I(2),\ \ldots,\ U(t),\ I(t),\ D(t+1)$$

dove $U(t)$, $I(t)$, $D(t)$ denotano utilizzo, decisione circa l'investimento e domanda al tempo $t$ (come nel « diagramma di flusso » in Figura 1). Il nuovo utilizzo è determinato definendo una funzione $f(D(t), I(t-1)$ e ponendo

$$\begin{aligned} U &= 0 \quad \text{se} \quad f(D, I) <= 0 \\ U &= 1 \quad \text{se} \quad 0 < f(D, I) <= 1/3 \\ U &= 2 \quad \text{se} \quad 1/3 < f(D, I) <= 2/3 \\ U &= 3 \quad \text{se} \quad 2/3 < f(D, I) <= 1 \\ U &= 4 \quad \text{se} \quad f(D, I) > 1. \end{aligned}$$

Se ci si limita a considerare funzioni lineari possiamo scrivere $(f(D, I) = g\,D + h\,I.\ D(t)$ è una sequenza di variabili casuali identicamente ed indipendentemente distribuite.

Ne consegue che dato $I(t-1)$ la distribuzione di $U(t)$ è completamente determinata dalla distribuzione di $D(t)$ [5].

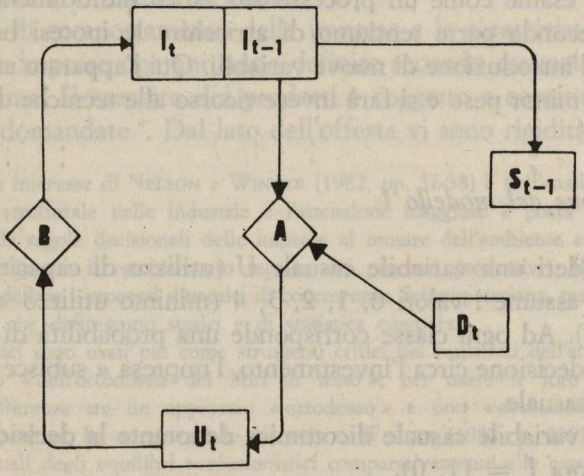


FIGURA 1.

[5] La domanda entra nel modello come una variabile casuale esogena per i soggetti economici. Ciascuna impresa si ritrova una domanda di cui conosce solamente il campo di variazione: la quantità domandata di prodotti potrà determinare un qualsiasi utilizzo (basso, intermedio, elevato) dell'impianto nella dimensione ($k$) scelta. La decisione di investire è parzialmente vincolante per il prossimo periodo perché muove il baricentro della quantità domandata, ma senza offrire garanzie di una domanda adeguata per l'impianto scelto. La domanda qui interviene solo in qualità di incrementi di domanda. Una volta raggiunta la dimensione ($k + 1$) il campo di variazione degli incrementi di domanda è limitato all'intervallo

Si è scelta come distribuzione di $D(t)$ una legge beta di parametri $m$ e $n$. Al variare di $m$ e $n$ variano i momenti della distribuzione. In particolare se $m = n$ la distribuzione è simmetrica.

Una possibile specificazione della funzione di utilizzo è la seguente

$$f(D(t), I(t)) = 2\,D(t) - I(t-1) \qquad (1)$$

Conviene ora introdurre una matrice $A$ $(5 \times 2)$ di probabilità condizionali

$$a_{ij} = Pr(U = i - 1 | I = j - 1) \qquad i = 1, \ldots, 5; \qquad j = 1, 2.$$

Le $\{a_{ij}\}$ sono completamente determinate una volta scelti i parametri $m$ e $n$ e la specificazione (1). Inoltre, come si può vedere, sono indipendenti da $t$.

Analogamente si può definire una matrice $B$ $(5 \times 2)$ di propensioni all'investimento dato l'utilizzo, cioè

$$b_{ij} = Pr(I = j - 1 | U = i - 1) \qquad i = 1, \ldots, 5; \qquad j = 1, 2.$$

Scriviamo per comodità $A = P(U(t)|I(t))$. Se assumiamo propensioni costanti sarà $B = P(I(t)|U(t))$.

È facile vedere che il processo si riduce a un processo di Markov nella sola variabile $I(t)$ con matrice di transizione $C = B'A$, dove $B'$ indica la trasposta di $B$,

$$c_{ij} = Pr(I(t+1) = i - 1 | I(t) = j - 1) \qquad i = 1, 2; \qquad j = 1, 2.$$

Se si indica con $P(I(t))$ il vettore colonna il cui elemento $i$-esimo è

$$Pr(I(t) = i - 1) \qquad i = 1, 2$$

allora

$$P(I(t+1)) = C\,P(I(t)).$$

Il processo è in genere ergodico, quindi indipendente dalle condizioni iniziali, e la distribuzione limite di $I(t)$ sarà data dall'autovettore destro di $C$ corrispondente all'autovalore $= 1$.

Se $P(U(t))$ indica il vettore $(5 \times 1)$ tale che l'elemento $i$-esimo è $Pr(U(t) = i - 1)$, $i = 1, \ldots, 5$, possiamo scrivere

$$P(U(t)) = A\,P(I(t-1)) \quad \text{e} \quad P(U(t+1)) = A\,B'\,P(U(t)).$$

$(k-1) - (k+1)$. La parte $(k-1)$ di domanda è garantita, come se operasse un vincolo estremamente rigido di concorrenza monopolistica.

Si definisca ora la variabile casuale « dimensioni »

$$S(t) = \sum_{k=1}^{t} I(k).$$

Si noti che

$$Pr(S(t+1) = k | S(t) = k \wedge S(t-1) = k) = c_{11}$$
$$Pr(S(t+1) = k | S(t) = k \wedge S(t-1) = k-1) = c_{12}$$
$$Pr(S(t+1) = k+1 | S(t) = k \wedge S(t-1) = k) = c_{21}$$
$$Pr(S(t+1) = k+1 | S(t) = k \wedge S(t-1) = k-1) = c_{22}$$

così che $S(t)$ è un processo autoregressivo del secondo ordine (o un processo di Markov del secondo ordine).

## 2.2. *Meccanismi di adeguamento*

Un arricchimento del modello suesposto è descritto nel « diagramma di flusso » in Figura 2. L'elemento di novità è dato dall'introduzione della variabile « profitto » come misura del successo delle decisioni delle imprese. Esse possono commettere due tipi di errore: i) investire e ritrovarsi con un grande eccesso di capacità inutilizzata; ii) non investire e trovarsi con un utilizzo di capacità assai elevato e con l'impossibilità di soddisfare una parte

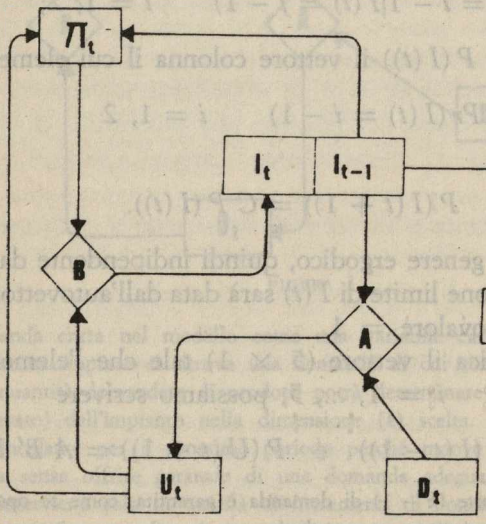


FIGURA 2.

della domanda. La funzione profitto è definita in modo da dare maggior peso al I tipo di errore.

In questa specificazione la variabile profitto ($\Pi$) determina una scelta tra due schede di propensioni condizionali all'investimento, rappresentate da due matrici $B_1$ e $B_2$ (le probabilità condizionali di investimento in $B_2$ sono maggiori di quelle rispettive in $B_1$).

Questo implica la definizione di una regola di scelta tra le due matrici. Introduciamo allora due ipotesi di comportamento riassumibili nella tabella seguente:

MECCANISMO A (HOMO « CONFORMISTA »)

| al tempo $t$ | | bassa propensione ad investire | alta propensione ad investire |
|---|---|---|---|
| al tempo $t+1$ | bassi profitti | + | − |
| | alti profitti | − | + |

MECCANISMO B (HOMO « SCHUMPETERIANO »)

| al tempo $t$ | | bassa propensione ad investire | alta propensione ad investire |
|---|---|---|---|
| al tempo $t+1$ | bassi profitti | − | − |
| | alti profitti | + | + |

dove i caratteri + e − significano alta e bassa propensione ad investire al tempo $t + 1$.

Nel caso A la regola che determina la scelta dell'investimento può essere riassunta nel modo seguente. L'impresa va alla ricerca di un comportamento soddisfacente. Alti profitti al tempo $t + 1$ sono un indice di correttezza delle scelte operate al tempo $t$. In questo caso l'impresa mantiene la stessa scheda delle propensioni all'investimento. Nel caso di bassi profitti ne utilizza un'altra. Nel caso B la scelta dell'investimento è determinata unicamente dai profitti ottenuti in $t + 1$. Se i profitti sono alti l'impresa investe indifferentemente alla regola di comportamento al tempo $t$.

Si potrebbe dire che nel caso B la crescita è comunque un obiettivo per l'impresa, ma con il vincolo di ottenere alti profitti per poter attuare una politica di investimento aggressiva. Nel caso A il profitto è l'obiettivo dell'impresa che è però cieca nello stabilire una regola di comportamento. Se è

soddisfatta dei risultati conseguiti l'impresa accetta per buona anche per il futuro la regola di comportamento che l'ha portata dove si trova. Altrimenti prova a cambiare.

La variabile casuale profitto rappresenta punteggi assegnati alle combinazioni ($U = i \wedge I = j$): acquisterà pertanto, nelle nostre ipotesi, 10 valori. Possiamo rappresentare i suoi valori con una matrice $Q(5 \times 2)$ dove l'elemento $(i - j)$-esimo è il punteggio assegnato al trovarsi in utilizzo $= i - 1$ e decisione di investimento $= j - 1$.

La caratteristica saliente del punteggio scelto per rappresentare il profitto è la seguente:

$$E(\Pi|I = 1) \approx E(\Pi|I = 0)$$
$$\text{Var}(\Pi|I = 1) > \text{Var}(\Pi|I = 0).$$

Questo traduce il fatto che l'investimento è un evento a cui è abbinato un certo rischio.

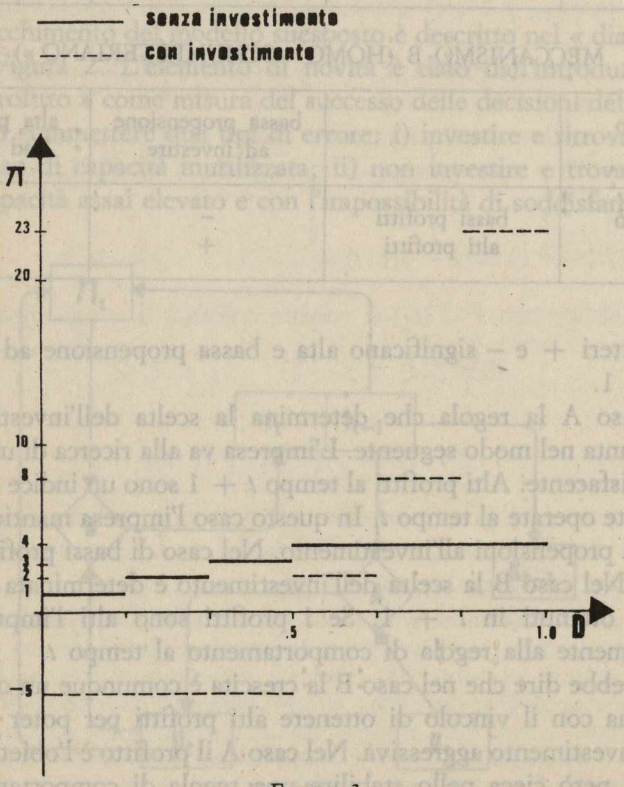


FIGURA 3.

Il profitto risulta quindi funzione dell'utilizzo e dell'investimento al tempo precedente. Fissato il valore dell'investimento si può esprimere il profitto come funzione della domanda: è quanto delineato in Figura 3.

La sua distribuzione è pertanto data dalla distribuzione congiunta di $U(t)$ e $I(t-1)$:

$$P(U(t), I(t-1)) = A \text{ Diag}\{P(I(t-1))\}$$

dove Diag $\{x\}$ è la matrice diagonale i cui elementi sono gli elementi del vettore $x$.

Si definisce ora:

$$\rho(t) = Pr(\Pi(t) < E(\Pi(t)).$$

Per comodità definiamo $X(t) = 0$ quando $\Pi(t) < E(\Pi(t)$ e $X(t) = 1$ quando $\Pi(t) \geq E(\Pi(t))$ e quindi $\rho(t) = Pr(X(t) = 0)$.

La regola di adeguamento A può essere così esposta: se l'individuo al tempo $t$ osserva $X(t) = 0$ cambia matrice di propensioni all'investimento; se osserva $X(t) = 1$ mantiene la stessa matrice.

Sia $\mathcal{B}(t)$ un elemento aleatorio che assume i valori $B_1$, $B_2$, con distribuzione

$$\mu(t) = \begin{bmatrix} Pr(\mathcal{B}(t) = B_1) \\ Pr(\mathcal{B}(t) = B_2) \end{bmatrix} = \begin{bmatrix} \mu(t, 1) \\ \mu(t, 2) \end{bmatrix}$$

Al tempo $t$ consideriamo la relazione

$$M(t) = \mu(t, 1)\, B_1 + \mu(t, 2)\, B_2.$$

$M(t)$ rappresenta il « comportamento » medio, è una grandezza aggregata e quindi influisce sulla propensione media ad investire e quindi sulla distribuzione dei profitti. Ne consegue, utilizzando le vecchie relazioni con $M$ in luogo di $B$:

$$P(I(t)) = [M(t)]' A P(I(t-1))$$

$$P(U(t+1), I(t)) = A \text{ Diag}\{P(I(t))\}$$

da cui $\Pi(t+1)$ e conseguentemente

$$\rho(t+1) = Pr(\Pi(t+1)) < E(\Pi(t+1)).$$

Scrivendo $\Theta(t+1) = \begin{bmatrix} 1-\rho(t+1) & \rho(t+1) \\ \rho(t+1) & 1-\rho(t+1) \end{bmatrix}$ otteniamo

l'equazione alle differenze

$$\mu(t+1) = \Theta(t+1) \cdot \mu(t).$$

Il processo $\{\mathfrak{B}(t)\}$ come definito converge a $\mathfrak{B}$ tale che

$$Pr(\mathfrak{B} = B_1) = 1/2$$

$$Pr(\mathfrak{B} = B_2) = 1/2$$

Pertanto $\lim_{t \to \infty} [M(t)]' A = 1/2 (B_1' + B_2') A$ e il processo $I(t)$ converge verso uno stato stabile.

Nel caso del meccanismo $B$ non ci pare possibile definire analiticamente l'esito del processo stocastico, ma la convergenza è stata verificata sperimentalmente per un grande ventaglio di valori dei parametri. Stando così le cose si può, quindi, ancora parlare di distribuzioni limite delle variabili investimento e utilizzo.

### 2.3 *Le distribuzioni limite degli investimenti e dell'utilizzo di capacità*

Si è tentato di analizzare la sensibilità delle distribuzioni limite di $I$ e $U$ per variazioni degli elementi delle matrici $A$ e $B$. Siccome la matrice $A$ è essenzialmente determinata dalla distribuzione beta prescelta e quindi determinata dai due parametri di questa classe di distribuzioni si è pensato di cogliere le variazioni come variazioni della varianza della beta (il che equivale, si ricordi, a variazioni della domanda) [6].

Rappresentiamo la distribuzione limite di $I$ con il vettore $P(p(0), p(1))$: allora si può concludere che $p(1)$ cresce al crescere della varianza quando la distribuzione della domanda ha asimmetria negativa, decresce al crescere della varianza quando la distribuzione della domanda ha asimmetria positiva. Inoltre per la stessa varianza:

$p(1)$ (domanda con asimmetria negativa) $= >$ $p(1)$ (domanda con asimmetria positiva); e ancora:

$p(1)$ (domanda con asimmetria negativa) $= >$ $1/2$.

Se la domanda è simmetrica non ci sono risultati conclusivi.

Per quanto riguarda la variabile $U$ si ha:

---

[6] Si sono scelti valori dei parametri in modo da ottenere differenti valori della varianza e dell'indice di asimmetria. L'asimmetria positiva può significare un ristagno della domanda, l'asimmetria negativa una domanda che si espande.

i) una distribuzione a « $U$ » si ottiene tipicamente per distribuzioni simmetriche della domanda

ii) una distribuzione unimodale quasi simmetrica emerge da distribuzioni della domanda con asimmetria negativa e media varianza.

Per quanto riguarda i meccanismi di aggiustamento A e B è interessante notare che non sembrerebbero emergere rilevanti differenze di comportamento così che strutture apparentemente piuttosto diverse non sembrano dare origine a risultati chiaramente distinguibili.

### 3.1 *Descrizione del modello II*

Il « diagramma di flusso » del modello è in Figura 4.

Legenda delle variabili:

$D$ : domanda
$U$ : utilizzo di capacità
$I$ : investimento
$S$, $S'$: dimensioni
$E$ : numero di imprese operanti
$N$ : numero di imprese che divengono attive
$M$ : numero di imprese che cessano l'attività produttiva
$\Delta$ : disinvestimenti
$\Pi$ : profitto

Nel seguito descriviamo la struttura del processo.

1. Al tempo $t = 0$ c'è un insieme di imprese potenziali, di queste $E$ sono operanti nella dimensione minima e caratterizzate da un livello di utilizzo di capacità produttiva arbitrariamente assegnato. Ad ogni livello di utilizzo è associata, come nel modello $I$, una probabilità di investire. Queste probabilità sono gli elementi di una matrice $B$. La decisione di investimento determina la nuova dimensione.

2. Le imprese dispongono di statistiche ex-ante sul campo di variazione della media della domanda. Condizionalmente (in senso probabilistico) a queste statistiche l'impresa fronteggia una domanda che è una variabile casuale le cui media e varianza dipendono dalla dimensione raggiunta.

3. Nuovamente come nel modello I definiamo ora l'utilizzo una funzione della domanda e della scelta di investimento. Quindi ad ogni impresa è associato un grado di utilizzo di capacità.

4. Dato il suo utilizzo, la propensione a investire dell'impresa dipende innanzitutto dalla sua decisione di fare o meno previsioni. Nel caso abbia

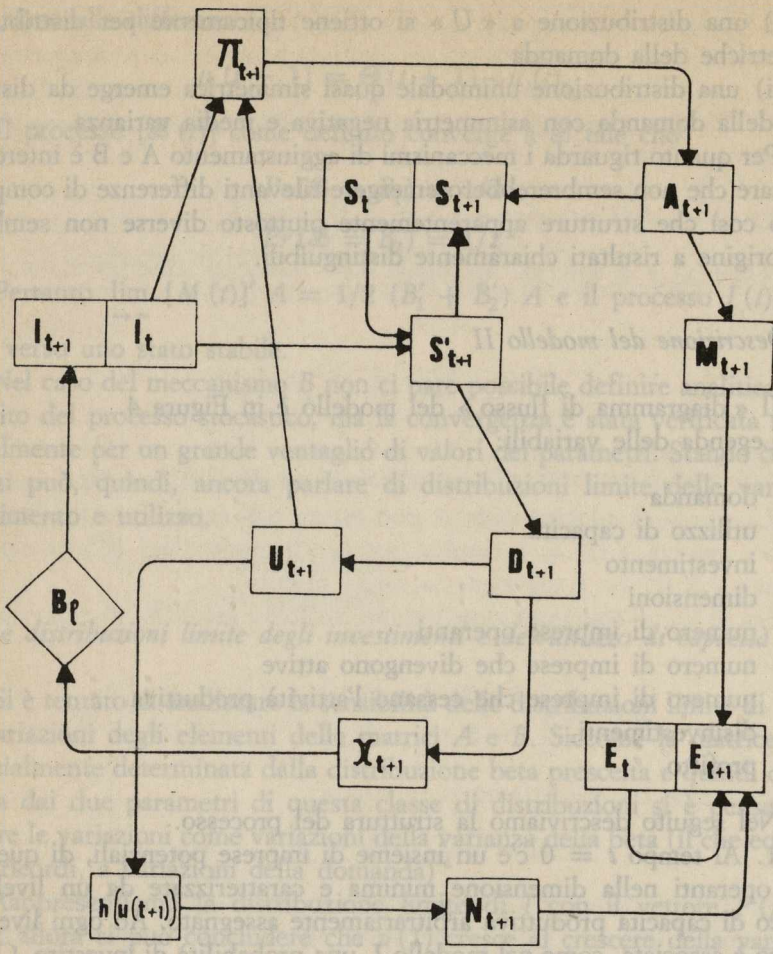


FIGURA 4.

deciso di fare previsioni la propensione dipende dalla previsione. Questo determina la nuova dimensione.

5. La distribuzione empirica dell'utilizzo di capacità descrive la relazione di domanda e offerta nel sistema delle imprese. Il prevalere di una forma a *J* di questa distribuzione costituisce un incentivo per l'entrata di nuove imprese nel sistema; in altre parole l'ingresso è dovuto alla presenza di un eccesso di utilizzo di capacità nel sistema.

6. Definiamo ora la variabile profitto come misura del successo delle decisioni delle imprese. Questa variabile mantiene essenzialmente le caratteristiche della variabile profitto nel modello I. Se l'impresa realizza un profit-

to piuttosto basso disinveste e ridefinisce la sua dimensione. Viene definita una dimensione zero (limbo) come limite inferiore: l'$n$-esimo ritorno alla dimensione zero determina l'uscita dell'impresa dal mercato.

7. È possibile ora aggiornare il numero delle imprese operanti.
Il processo prosegue ripartendo da 2.

### 3.2 *Formalizzazione del modello*

Dato $N = n$ sia

$$\mathcal{R}(i) \sim U[0, 1] \qquad i = 1, \ldots, n$$

ed indipendentemente distribuite.

Allora la domanda relativa all'$i$-esima impresa in dimensione $k$ è distribuita, condizionalmente a $\mathcal{R}$, secondo una legge normale

$$D(i, S = k|\mathcal{R} = R) \sim \mathcal{N}(f_1(k)\, R, f_2(k)).$$

Nelle simulazioni si è posto come media

$$\mu = f_1(k)\, R = \frac{k^2}{k+1} + \frac{k}{k+1} R$$

e varianza

$$\sigma^2 = f_2(k) = \log_{10}(k + 9).$$

L'effetto di $R$ è di rendere eguale a $k$ il valore massimo che assume la media della domanda e il valore minimo eguale a $\dfrac{k^2}{k+1}$.

Implicitamente viene così costruita una distribuzione di probabilità per la quota garantita della domanda [7].

La funzione che determina l'utilizzo di capacità in modo analogo al modello $I$ è

$$f(D(S = k),\, I(t-1)) = \frac{1}{a+2} D(S = k) - \frac{k-2}{a+2} +$$

[7] L'impresa che si trova ad operare nella dimensione $k$ ha capacità di produzione $X(k)$ al tempo $t$. Una quota di $X$, diciamo $gX(k)$, della domanda è certa al tempo $t + 1$. Nella specificazione del modello $g$ è una variabile casuale funzione di $R$ e $k$ che definisce un certo grado di monopolio dal lato delle quantità di prodotto. Con le specificazioni della simulazione

$$+\left[\frac{a-b}{(a+b)(b+2)}\,D(S=k)+\frac{k-2}{a+2}-\frac{k-b}{b+2}\right]I(t-1) \qquad (2)$$

dove $0 < a, b < 1$.

La figura 5 riporta le due rette determinate dall'equazione 2) quando $I(t) = 0$ e quando $I(t) = 1$.

Se $a = b$

$$f(D, I) = \frac{1}{b+2}\,D(S=k) - \frac{k-2}{b+2} + \frac{b-2}{b+2}\,I(t-1).$$

« $a$ » e « $b$ » sono due parametri che influenzano l'elasticità del grado di utilizzo della capacità al variare della domanda: valori relativamente elevati di $a$ significano la possibilità di far fronte a una domanda inaspettatamente alta senza raggiungere il massimo utilizzo della capacità; valori relativamente elevati di $b$ significano la possibilità di fronteggiare una domanda sorprendentemente bassa senza che si debba produrre con un livello di utilizzo di capacità minimo.

Sia ora: $\mathcal{H}$ = statistica d'ordine di $\{\mathcal{R}(1), \ldots, \mathcal{R}(n)\}$.

La distribuzione del rango di $\mathcal{H}$ determina la ripartizione delle imprese in quelle indifferenti a previsioni e in quelle adottanti tecniche previsive. Le prime adottano una scheda di propensioni all'investimento $B_0$. La distribuzione della prima statistica d'ordine determina la ripartizione delle imprese che formulano previsioni in tre gruppi: quelle adottanti alte propensioni all'investimento, quelle adottanti medie propensioni, e quelle adottanti basse propensioni. Si danno pertanto esogenamente tre matrici $B_1$, $B_2$, $B_3$, generalizzando quanto esposto a pag. 7, ultimo paragrafo, con la stessa definizione dei simboli.

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stocastica $g$ ha le caratteristiche probabilistiche descritte nella tabella seguente per alcuni valori delle dimensioni $k$.

15° PERCENTILE DI $g$ PER ALCUNI VALORI DELLE DIMENSIONI $k$ E DI $R$ MINIMO (= 0) E MASSIMO (= 1)

| | $R = 0$ | $R = 1$ |
|---|---|---|
| $k = 5$ | $g = .52$ | $g = .68$ |
| $k = 7$ | .65 | .77 |
| $k = 10$ | .74 | .83 |
| $k = 15$ | .82 | .88 |
| $k = 20$ | .86 | .91 |

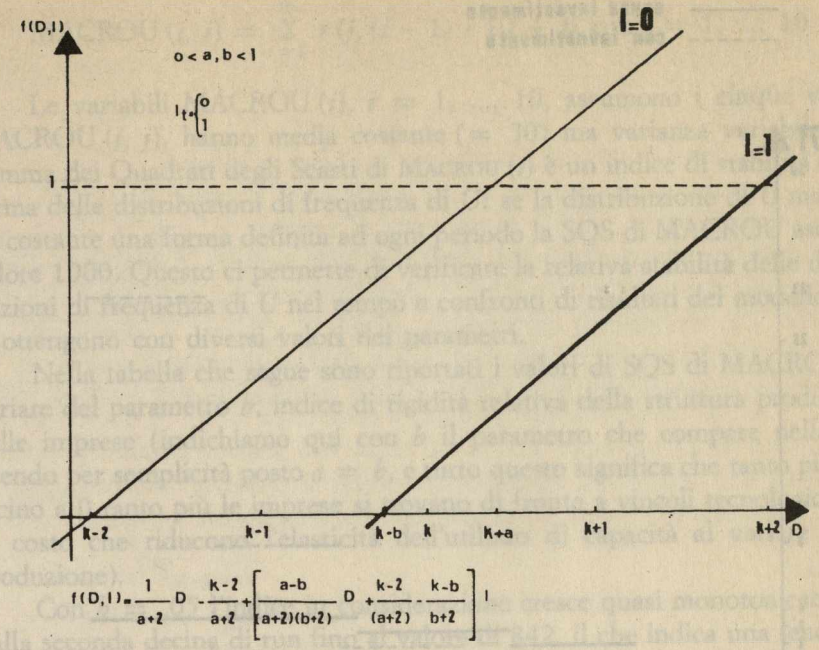


FIGURA 5.

La Figura 6 rappresenta la variabile profitto in funzione della domanda nel modello II.

La variabile $\Delta$ (disinvestimenti) acquista valori $(0, -1)$ ed è definita come funzione del profitto.

Le dimensioni sono definite dalle seguenti equazioni

$$S'(t+1) = S(t) + I(t)$$
$$S(t+1) = S'(t+1) + \Delta(t+1)$$
$$S(0) = 1.$$

Sia $h(u(t))$ la funzione di distribuzione empirica della variabile casuale $U(t)$. Il numero massimo delle imprese che possono diventare attive $(N)$ dipende dal numero di imprese esistenti e la probabilità di ingresso per ogni singola impresa potenziale dipende dalla $h(u(t))$. Quindi il numero delle imprese operanti al tempo $t+1$ è dato da

$$E(t+1) = E(t) + N(t+1) - M(t+1).$$

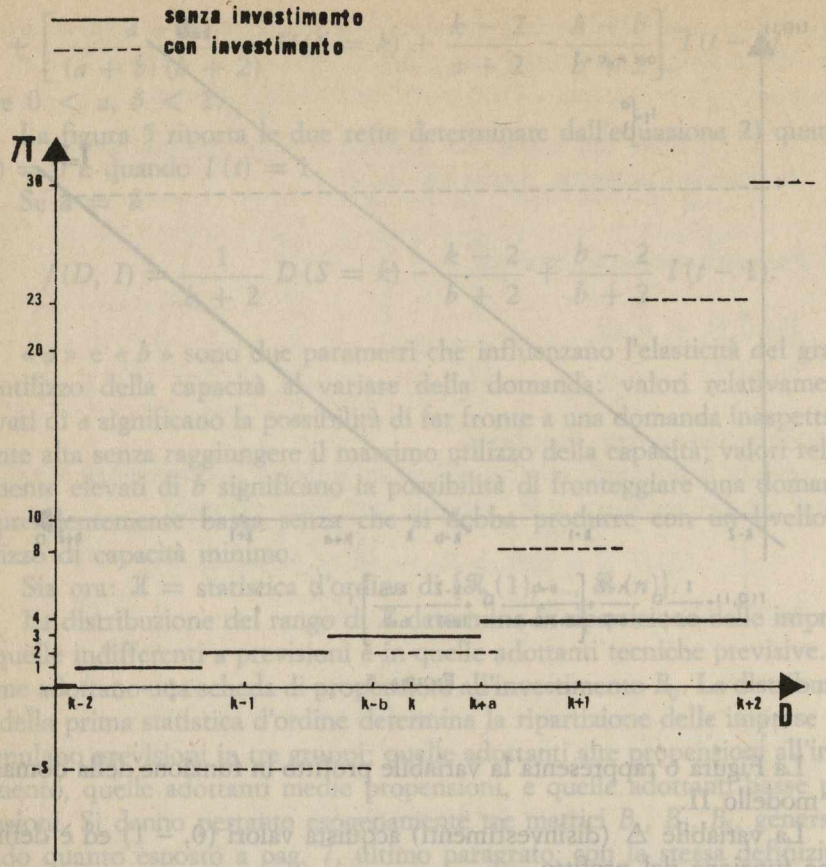


FIGURA 6.

### 3.3 *Statistiche delle simulazioni effettuate*

Il nostro primo oggetto di analisi è lo stato del sistema, definito dalle distribuzioni degli utilizzi di capacità, degli investimenti e delle dimensioni delle imprese. Come si è già detto nell'introduzione per il modello fin qui esposto abbiamo seguito la strada delle simulazioni stocastiche ottenendo distribuzioni empiriche delle variabili di interesse.

a) *La distribuzione della variabile utilizzo di capacità.* – Abbiamo costruito una variabile $r$, rango degli utilizzi. Sia $f_j$ la frequenza relativa di $(U(t) = j)$ per $j = 0, ..., 4$ al tempo $t$. Si ordinino in modo crescente le $f_j$ e sia $\ell$ la posizione assunta da $f_j$ in questo ordine: $\ell = 1, ..., 5$. Si ponga ora $r(j, t) = \ell$ e definiamo:

$$\text{MACROU}(i, j) = \sum_{t=1}^{10} r(j, (i-1) \cdot 10 + t) \text{ con } i = 1, \ldots, 10$$

Le variabili MACROU ($i$), $i = 1, \ldots, 10$, assumono i cinque valori MACROU ($i$, $j$), hanno media costante ($= 30$) ma varianza variabile. La Somma dei Quadrati degli Scarti di MACROU ($i$) è un indice di stabilità della forma delle distribuzioni di frequenza di $U$: se la distribuzione di $U$ mantiene costante una forma definita ad ogni periodo la SQS di MACROU assume valore 1000. Questo ci permette di verificare la relativa stabilità delle distribuzioni di frequenza di $U$ nel tempo e confronti di risultati del modello che si ottengono con diversi valori dei parametri.

Nella tabella che segue sono riportati i valori di SQS di MACROU al variare del parametro $b$, indice di rigidità relativa della struttura produttiva delle imprese (indichiamo qui con $b$ il parametro che compare nella (2) avendo per semplicità posto $a = b$, e tutto questo significa che tanto più $b$ è vicino a 0 tanto più le imprese si trovano di fronte a vincoli tecnologici e/o di costo che riducono l'elasticità dell'utilizzo di capacità al variare della produzione).

Con $b = .05$ l'indice in considerazione cresce quasi monotonicamente dalla seconda decina di run fino al valore di 842, il che indica una tendenza verso una relativa stabilità della forma della distribuzione. Con $b = .4$ vi è una accentuata instabilità relativa. Con $b = .9$ si hanno valori spesso elevati di SQS di MACROU ma non vi è una tendenza verso la stabilizzazione (sia pure relativa).

Le forme predominanti nella distribuzione di frequenza di $U$ nel caso di $b$ molto piccolo tendono verso distribuzioni bimodali (sovente ma non

SQS DI MACROU PER VALORI DEL PARAMETRO $B$

| | $b = .9$ | $b = .5$ | $b = .4$ | $b = .1$ | $b = .05$ |
|---|---|---|---|---|---|
| MACROU1 | 757.5 | 340.0 | 177.0 | 484.5 | 639.0 |
| MACROU2 | 764.5 | 464.5 | 174.5 | 727.5 | 345.5 |
| MACROU3 | 821.5 | 534.0 | 325.0 | 648.5 | 472.0 |
| MACROU4 | 622.0 | 449.5 | 166.0 | 725.5 | 672.5 |
| MACROU5 | 818.5 | 241.0 | 254.0 | 652.5 | 526.5 |
| MACROU6 | 691.0 | 543.5 | 34.0 | 716.0 | 659.0 |
| MACROU7 | 728.5 | 348.5 | 531.0 | 685.0 | 689.5 |
| MACROU8 | 826.0 | 368.5 | 242.5 | 703.0 | 768.0 |
| MACROU9 | 585.5 | 376.0 | 210.5 | 778.0 | 801.0 |
| MACROU10 | 680.0 | 350.5 | 203.5 | 611.5 | 842.5 |

necessariamente con forme ad « *U* »). Nel caso di *b* grande troviamo abbastanza frequentemente distribuzioni unimodali ma con una dinamica piuttosto irregolare.

b) *Numero di imprese, investimenti e disinvestimenti.* – La Figura 7 riporta i grafici degli andamenti del numero di imprese in attività nella sequenza considerata (NVV = numero di imprese in attività al tempo *t* sull'asse delle ordinate; il tempo *t* sull'asse delle ascisse). Anche qui facendo variare solo il parametro *b* (*b* = .1, trend identificato dal simbolo grafico □, *b* = 25, identificato dal simbolo grafico *, e *b* = .5, identificato dal simbolo △) il numero di imprese cresce considerevolmente con *b* = .1, cresce relativamente con *b* = .25, e rimane sostanzialmente costante con *b* = .5.

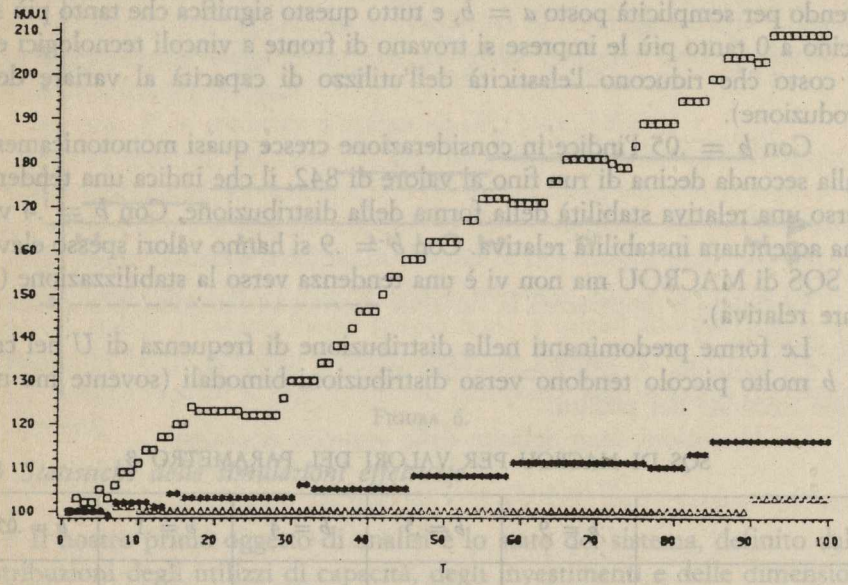


FIGURA 7. (Ordinate: numero di imprese; ascisse: tempo)

Contando ad ogni giro il numero di imprese che investono e di quelle che disinvestono e facendone la media per i modelli *b* = .1, *b* = .25 e *b* = .5 otteniamo:

| | | | |
|---|---|---|---|
| frequenze investimenti | = .33 | .32 | .31 |
| frequenze disinvestimenti | = .25 | .24 | .20 |

c) *Dimensioni delle imprese.* – Per brevità non riproduciamo qui gli

istogrammi delle distribuzioni dimensionali delle imprese al tempo $t = 100$ sempre per l'insieme di parametri sopra definiti, ma dal loro confronto emerge che: i) la moda cresce al crescere del parametro $b$; ii) l'istogramma delle dimensioni ha una forma con asimmetria positiva quando $b = .1$, quasi simmetrica con $b = .25$, e più irregolare ma con una tendenziale asimmetria negativa quando $b = .5$.

L'unità di investimento può essere assegnata alle imprese secondo una regola di proporzionalità. Gli ampliamenti della scala della produzione obbediscono allora ad un vincolo di un ampiamento minimo proporzionale alla dimensione in precedenza raggiunta. Con l'ipotesi di un fattore di proporzionalità fisso (pari al 10% della dimensione raggiunta al tempo $t - 1$) ne risultano gli istogrammi delle distribuzioni delle dimensioni delle imprese che assumono le forme riprodotte a titolo di esempio nelle Figure 8 e 9. In generale possiamo dire che con valori di $b$ medio bassi otteniamo distribuzioni che presentano asimmetria positiva più o meno accentuata, con valori alti di $b$ si ottengono istogrammi che presentano contorni più irregolari.

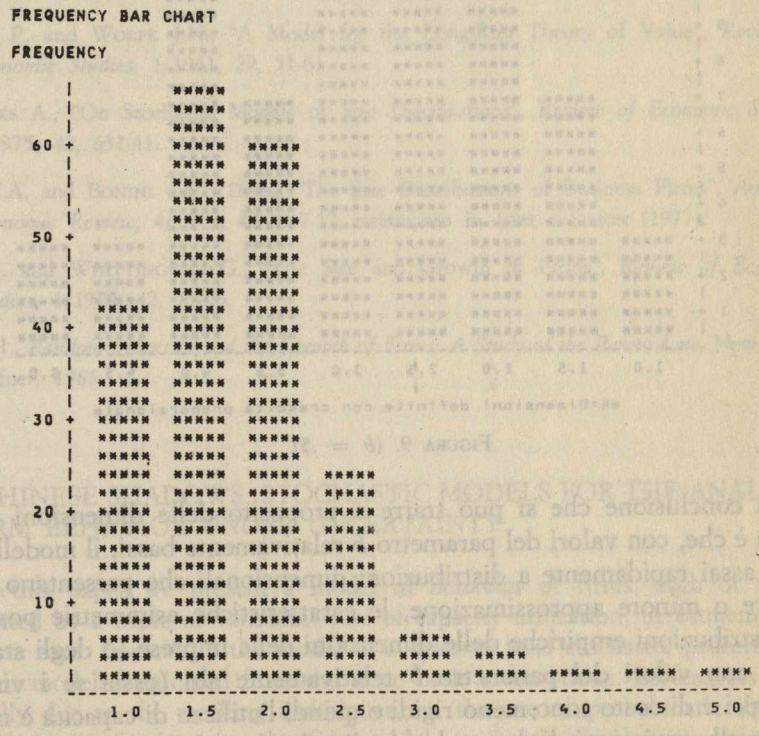


FIGURA 8. ($b = .1$)

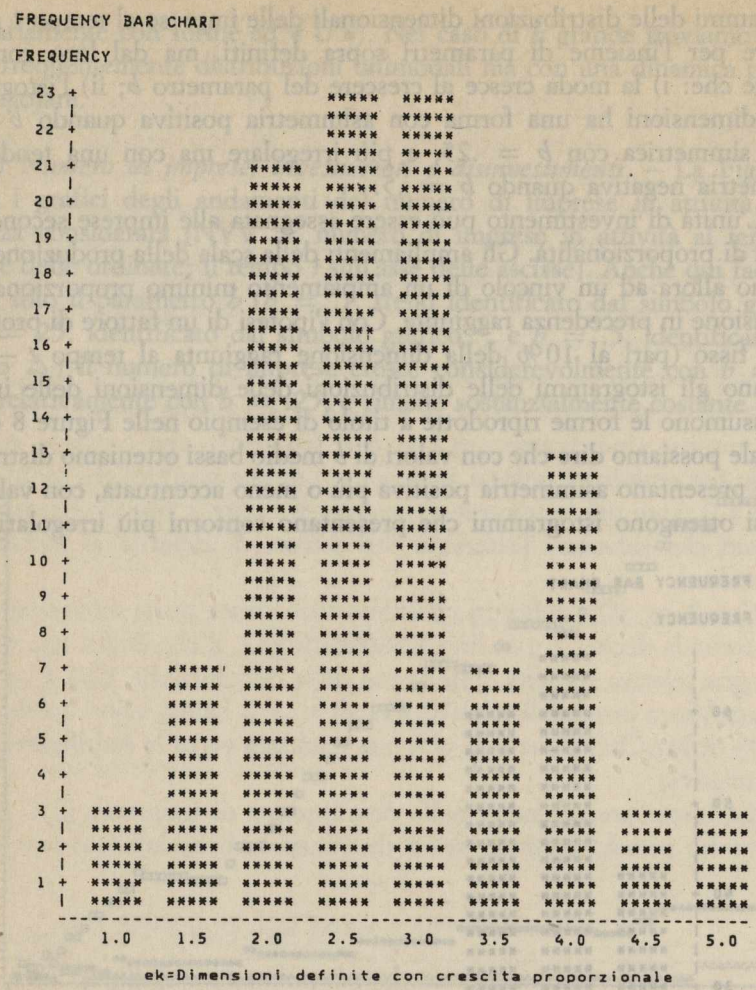


FIGURA 9. ($b = .5$)

La conclusione che si può trarre a proposito delle dimensioni delle imprese è che, con valori del parametro $b$ relativamente bassi, il modello dà origine assai rapidamente a distribuzioni dimensionali che presentano, con maggiore o minore approssimazione, le caratteristiche asimmetrie positive delle distribuzioni empiriche delle dimensioni delle imprese (o degli stabilimenti); con valori del parametro $b$ relativamente alti (ossia se i vincoli tecnologici e di costo sono meno rigidi e quindi l'utilizzo di capacità è meno sensibile alle variazioni di domanda), le distribuzioni delle dimensioni risultanti approssimano meno rapidamente le distribuzioni empiriche.

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STEINDL J., *Random Processes and the Growth of Firms: A Study of the Pareto Law,* New York: Hafner, 1965.

## THE CHINESE SHADOWS: STOCHASTIC MODELS FOR THE ANALYSIS OF FIRM BEHAVIOR UNDER UNCERTAINTY

In this paper we present a model of behavior of firms, each of which represented by a triple of variables: rate of capacity utilization, investment decision, firm size. Essentially the model is a discrete time stochastic process. We built two models originated from the same basic assumptions. Differences were essentially due to the working techniques, ie: the use of probabilistic tools to derive limit distributions for the first model, stochastic simulations generating empirical distributions of these variabiles for the second one.

Minimal assumptions define firm behavior rules and environmental scenarios. The firms face a stochastic demand: forecasted quantities may differ substantially from the actually realized ones. Consequently investment decisions are characterized by uncertainty. Such decisions affect the rate of capacity utilization: if the forecasted quantities are greater than those realized, then the firm ends up with a low rate; the opposite is true in the case of smaller quantities. Now a low rate affects the investment propensity in a negative way; on the other hand a high rate tend to increase the investment propensity.

Basically firms are after a satisfying rate of capacity utilization. A profit function is defined without explicit reference to optimal behavior models hinged to the classical theory of profit maximisation. In this respect we follow the literature on stochastic models of firms size.

Actually in our model investments are firm size decisions.

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# TECHNOLOGICAL CHANGE AND ITS IMPACT ON PRODUCTIVITY: THE U.S. STEEL INDUSTRY

by
STEPHEN P. STAGEBERG *

## I. *Introduction*

In this paper we explore the impact of technological change on productivity in the U.S. steel industry. Heretofore an example of U.S. industrial strength, steel now has been beleagured by foreign competition for nearly a decade. While the role of technological change in productivity growth is generally significant, its origins are difficult to detect. Technological change may arise from lessons learned in the firm in the production process (endogenous) or from developments outside the firm and production process (exogenous). The endogenous source of technical change, labeled "learning by doing", has generated inquiry into its impact on productivity and how best to stimulate "learning".

Previous production studies of the steel industry have utilized industry-wide data and/or have neglected to test for the role of technological change. In this paper we use a four-firm sample drawn from the U.S. steel industry [1] to estimate a translog production function which includes variables representing exogenously and endogenously inspired technical change. We find evidence that technical change was primarily endogenous in the U.S. over the period 1960-1978.

In Section II we present a brief review of economic trends in the steel industry since 1960. In Section III we discuss the conceptual development of learning by doing and its measurement. Sections IV and V contain the

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[1] The selection of firms for the sample was determined by access to data and size of firm. National Steel, Republic, and Wheeling-Pittsburgh were the fourth, fifth, and eighth largest U.S. steel firms, respectively. Kaiser Steel, a much smaller and financially beleagured firm, was included to reflect those steel firms in severe financial distress.

description of our model and data, and our results, respectively. Section VI is our conclusion.

## II. *U.S. Steel Industry, 1960-85*

The U.S. steel industry has been slow to innovate. The basic oxygen furnace (BOF) developed in the fifties was quickly adopted in Japan and Europe. U.S. producers, however, clung to the higher cost open hearth furnaces. Thus, steel productivity in the U.S. rose very slowly in the sixties

TABLE 1
PRODUCTIVITY AND HOURLY WAGE RATE INCREASE IN U.S. STEEL INDUSTRY, 1960-1984 (percent annual growth)

| | Productivity | Hourly Wage Rate |
|---|---|---|
| 1961 | 7.0 | 3.9 |
| 1962 | 1.2 | 0.0 |
| 1963 | 8.0 | 5.0 |
| 1964 | 5.7 | 1.4 |
| 1965 | − 0.2 | 1.4 |
| 1966 | 3.3 | 3.4 |
| 1967 | 3.1 | 1.1 |
| 1968 | 1.9 | 5.5 |
| 1969 | 6.7 | 7.0 |
| 1970 | 0.8 | 3.1 |
| 1971 | 2.3 | 8.3 |
| 1972 | 7.6 | 12.7 |
| 1973 | 1.9 | 7.9 |
| 1974 | − 1.3 | 14.7 |
| 1975 | − 0.6 | 11.4 |
| 1976 | 5.6 | 10.5 |
| 1977 | 0.9 | 10.3 |
| 1978 | 4.4 | 11.8 |
| 1979 | n/a | 11.0 |
| 1980 | n/a | 9.9 |
| 1981 | 2.7 | 10.7 |
| 1982 | 2.7 | 6.4 |
| 1983 | 19.1 | − 4.0 |
| 1984 | 8.7 | 0.9 |

Source: *Annual Statistical Report*, American Iron and Steel Institute, *Wage Trends in the Iron and Steel Industry*, American Iron and Steel Institute.

and seventies. On the other hand, labor secured wage increases totalling 300 percent between 1960 and 1984, making U.S. steelworkers the most highly paid industrial workers in the world (see Table 1).

Since the 1959 U.S. steel strike, foreign penetration of the U.S. steel market thru 1978 surged every three years (see Table 2), paralleling labor contract negotiations. This market penetration has continued in the eighties with foreign steel accounting for more than one-quarter of the total U.S. market for steel in both 1984 and 1985, compared to 18.1 percent in 1978.

TABLE 2

U.S. PRODUCTION AND IMPORTS OF STEEL MILL PRODUCTS
(million tons)

| | Steel Production | Capacity | Imports | Share of Domestic Consumption (%) |
|---|---|---|---|---|
| 1960 | 99 | 148.2 | 3.3 | 4.6 |
| 1961 | 98 | 149.8 | 3.2 | 4.8 |
| 1962 | 98 | 150.1 | 4.1 | 5.6 |
| 1963 | 109 | 150.3 | 5.5 | 7.0 |
| 1964 | 127 | 151.7 | 6.4 | 7.3 |
| 1965 | 131 | 152.1 | 10.4 | 10.3 |
| 1966 | 134 | 153.3 | 10.8 | 10.9 |
| 1067 | 127 | 153.9 | 11.5 | 12.2 |
| 1968 | 131 | 154.5 | 18.0 | 16.7 |
| 1969 | 141 | 155.3 | 14.0 | 13.7 |
| 1970 | 131 | 154.8 | 13.4 | 13.8 |
| 1971 | 120 | 155.6 | 18.3 | 17.9 |
| 1972 | 133 | 154.5 | 17.7 | 16.6 |
| 1973 | 150 | 154.2 | 15.1 | 12.4 |
| 1974 | 145 | 154.7 | 16.0 | 13.4 |
| 1975 | 116 | 155.7 | 12.0 | 13.5 |
| 1976 | 128 | 159.8 | 14.3 | 14.1 |
| 1977 | 125 | 159.4 | 19.3 | 17.8 |
| 1978 | 137 | 157.8 | 21.1 | 18.1 |
| 1979 | 136 | 155.2 | 17.5 | 15.2 |
| 1980 | 112 | 153.7 | 15.5 | 16.3 |
| 1981 | 121 | 154.3 | 19.9 | 18.9 |
| 1982 | 75 | 154.0 | 16.7 | 21.8 |
| 1983 | 85 | 150.6 | 17.1 | 20.5 |
| 1984 | 93 | 135.3 | 26.2 | 26.4 |
| 1985 | 88 | 133.6 | 24.3 | 25.2 |

Source: *Statistical Highlights - U.S. Iron and Steel Industry*, American Iron and Steel Institute.

Obviously, recent U.S. steel price increases have been restrained. As a result, profit margins, held to about 6 percent in the sixties and seventies, have turned negative in the eighties.

From 1959 to 1978, steel production increased 38 percent while the productive capacity grew by 6.4 percent (see Table 2). Since 1978 production has declined 35.5 percent while productive capacity declined 15.3 percent as idle mills have been shut down. The steel industry expansion in the sixties and seventies paralleled the gradual replacement of the open hearth furnace by the BOF and more recently the electric furnace. In 1960 the open hearth furnace produced about 86 percent of U.S. raw steel, whereas in 1985 the BOF accounted for 58.8 percent and the electric furnace 33.9 percent of raw steel production.

The most significant years in this transformation of the basic steelmaking process in the U.S. were 1964-69. The open hearth process accounted for 98 million tons of raw steel in 1964 and 60 million tons in 1969. The BOF increased its production during the same period from 15 million to 60 million tons, or from 12 percent to 42.5 percent of total steel production. Similarly, the electric furnace increased production from 12 to 20 million tons. Overall production increased by 25.6 percent while annual real capital spending doubled from 1963 to 1968.

Despite these production advances, increased investment, and a 9.7 percent increase in real capital services per manhour, the annual rate of labor productivity improvement declined from 4 percent during 1960-65 to 2.2 percent during 1969-78. This slowdown in productivity growth was in part due to the fluctuation in capacity utilization that occurred in the seventies. Such fluctuation involved start-up and shutdown expenses that impede productivity gains. However, since 1978 labor productivity has soared some 55 percent with most of that improvement occurring after 1982 as firms speeded up the elimination of excess capacity.

Comparing the period 1960-63 with 1980-85, labor productivity improved since excess labor was laid off and blast furnaces were shut down. This could occur only if the industry were in the third region of production (negative marginal product) with no technical change, or in region II (declining but positive marginal product) if there were technical change. The casual evidence in these descriptive statistics points to technical change embodied in the new steelmaking processes replacing outmoded techniques. From 1961 to 1985 there was a 9.8 percent decrease in production capacity. Thus, investment spending went primarily to modernize the existing plant and equipment.

Our four-firm sample for this study was selected considering size of

TABLE 3

STEEL INDUSTRY AND SAMPLE PRODUCTIVITY
(percent annual growth, 1960-1978)

| | APL | APK | K/L |
|---|---|---|---|
| Industry | 3.00 | 2.30 | 0.76 |
| Sample | 2.30 | 3.20 | − 0.92 |
| | (1.47) * | (0.44) * | (0.76) * |
| Republic | 2.78 | 0.37 | 2.40 |
| National | 1.73 | 4.59 | − 2.73 |
| Wheeling-Pittsburgh | 3.36 | 5.04 | − 1.59 |
| Kaiser | − 0.69 | 15.30 | −13.88 |

* *t*-statistic for difference between industry and sample growth rate.

*APL* is average product of labor
*APK* is average product of capital
*K/L* is the capital-labor ratio

firm and availability of data. For a comparison of average productivity growth in this sample with the average industry-wide results see Table 3. Clearly there are no statistically significant differences between the overall industry-wide results and the sample. The steel industry is highly concentrated and the average trends of four large firms might be expected to reflect closely the industry.

Our sample shows a small annual decrease in capital intensity. There was little change in the quantity of labor or capital services employed by the sample firms during this period of study. Yet, production in the sample increased, indicating that technological progress must have occurred to boost factor productivity.

## III. *Learning by Doing*

The role of technological change is hypothesized to be significant in productivity enhancement. Economists understand that the sources of economic growth extend beyond mere increases in the factors of production. Indeed, growth depends on the manner in which those factors are combined in the production process, as well as the qualities embodied in those factors.

But, the problem remains to determine how much of an impact new technology has on productivity and wherein lie the sources of technological change.

Nelson (1964) expressed his concern that a time trend, frequently used in production functions to represent the impact of technological change, really measured our "ignorance" of what causes such change. Arrow (1962) began to distinguish "learning by doing" as a separate influence on productivity apart from any technological developments exogenous to the production process. Learning, the experience factor, is endogenous to the production process and includes technological changes in the production line emerging from experience.

As workers produce more output or devote increased time to their job functions, they gain experience. As workers become more familiar with their jobs and the operation of their tools and machinery, they may well learn how to improve their skills. They also may evolve ways to redesign the production process or the machinery. Thus, experience can lead to learning which may stimulate innovations.

There is a long-run and short-run learning curve associated with the production experience. The long-run allows the impact of technical progress embodied in new capital equipment as a firm expands or modernizes over time. The short-run, or "Horndal effect", pertains to learning by doing in an unchanged physical plant. This short-run learning results from endogenous skill advances of labor and the operation of the plant. Such short-run developments directly affect productivity growth.

It is easier to analyze the long-run because of the ease of using time-series data without concern for holding facilities fixed and the embodied technical progress therein. However, we miss the opportunity to find out the degree to which labor and capital productivity may have improved in unchanged facilities. At the same time, though, by restricting ourselves to fixed facilities, we lose the possibly significant impact of endogenously generated technical progress embodied in different vintages of capital stock. This impact affects both productivity and the bias of endogenous technical progress.

Arrow and others have attempted to determine what factor best measures the amount of experience or learning acquired. Cumulative gross investment, cumulative output, and cumulative years of experience of the firm are the three yardsticks most discussed. Certainly the turnover of the labor force could affect the amount of experience in a given firm, but this has been little discussed. As Dudley (1972) found, what may be the appropriate measure in one industry may not be in another. It may depend on the

degree of complexity in the production process and the amount of reflection necessary.

In this study cumulative output (*CUM*) and cumulative years of experience (*YR*) will be used to measure the growth of endogenously generated learning by doing. By using cumulative output the assumption is that by repetition of a function labor will become increasingly adept at its task and improved design of machinery and plant layout will result from acquired insight. On the other hand, what may be more important is the length of time needed to institute improved production processes which necessitate different training for workers, different machinery, or a different plant design. Many highly technical production processes also require reflection to improve their efficiency. In this situation more output does not significantly affect learning.

Obviously in the case of workers' learning, cost-reducing improvements may immediately be put into effect where they are employed. When workers move to another firm their learning is transmitted to that firm. The transmission mechanism from learning to increased productivity, then, may also operate through discovery in a particular firm of new technology and then its application there. It also may occur by skilled managers moving from one firm to another.

These ideas were explored in David's (1970) analysis of learning by doing in the antebellum U.S. cotton textile industry. That industry was protected by tariffs to permit production in the face of stiff English competition. While being protected, the firms in the industry hopefully gained efficiency-improving experience, or learning by doing. David hypothesized that the key to learning was not the quantity produced, but the number of years devoted to production. His premise was that the type of learning or experience most effective in advancing intra-firm productivity determines the type of protection defensible on infant industry grounds. David tested for the appropriate measure of learning by separately estimating Cobb-Douglas production functions with cumulative output and with cumulative years of experience included. He found that cumulative years of experience was the better measure due to a better fit of the production function and data when the years of experience variable was present.

Wills (1979) assessed the pattern of technical change in the primary metals industry after World War II by estimating a translog dual cost function using time series data. He found evidence of labor-saving and capital-using technical change; however, other than adding time (*T*) to the unit cost function symmetrically as an input, no variable explicitly represented learning by doing.

## IV. *Model and Data*

David's use of the Cobb-Douglas functional form, with its unitary elasticity of substitution and strong separability of parameters assumptions, is restrictive. Wills' analysis opened the door to the possibility of estimating a translog production function which included a variable to represent endogenous technical change. The transcendental logarithmic (translog) production function as set forth by Christensen, Jorgenson, and Lau (1972) is a more general functional form than Cobb-Douglas. This function is written as follows:

$$\text{(a)} \qquad \ln Q = \ln a_0 + \Sigma_i b_i \ln x_i + 0.5\, \Sigma_i \Sigma_j g_{ij} \ln X_i \ln X_j$$

where $Q$ is output, the $x_i$ are inputs, and $g_{ij} = g_{ji}$. Our model specifies five factor inputs: manhours ($L$), capital services ($K$), an input ($R$) to account for materials, energy usage, administrative labor, etc., cumulative output ($CUM$) or years of experience ($YR$) of the sample firms to account for endogenous learning, and a time trend ($T$) to represent the impact of exogenous technical change. $CUM$ and $T$ are included in non-logarithmic form.

One can estimate this function directly; however, to do so is difficult because of the high degree of expected collinearity among the independent variables. There is an indirect way to estimate the parameters of this function by means of establishing the factor cost share equations. First, we can find the output elasticity of $X_i$:

$$\text{(b)} \qquad d\ln Q/d\ln X_i = b_i + \Sigma_j g_{ij} \ln X_j$$

and

$$\text{(c)} \qquad d\ln Q/d\ln X_i = (dQ/dX_i)\,(X_i/Q)$$

Now assuming competitive factor markets,

$$\text{(d)} \qquad dQ/dX_i = P_i$$

where $P_i$ is the price of the $i$th factor relative to the price of $Q$. Setting $P$, the product price, equal to unity we have

$$\text{(e)} \qquad d\ln Q/d\ln X_i = (P_i X_i)/Q = M_i, \text{ or}$$

$$\text{(f)} \qquad M_i = b_i + \Sigma_j g_{ij} \ln X_j + e_i$$

where $M_i$ is the cost share of the $i$th factor and $e_i$ represents random disturbances.

In addition, we must include two more estimating equations to account for the impact of time ($T$) and endogenous learning by doing ($CUM$ or $YR$):

(g) $$d\ln Q/dT = b_T + \Sigma_i g_{iT} \ln X_i + g_{TT} T$$

(h) $$d\ln Q/dZ = b_z + \Sigma_i g_{iz} \ln X_i + g_{zz} Z \qquad \text{where } Z = CUM \text{ or } YR$$

Finally, we include three firm-specific dummy variables in each of the estimating equations to distinguish the differential impact of the four firms.

Assuming constant returns to scale as we do, then $\Sigma M_i = 1$ and, therefore, $\Sigma b_i = 1$ and $\Sigma_i g_{ij} = 0$. Since cost shares sum to one, only $n-1$ cost share equations are independent. Therefore, to avoid a singular disturbance covariance matrix we drop one cost share equation and jointly estimate the other $n-1$ equations using Zellner's Seemingly Unrelated Regression technique. Parameter values for the omitted equation can then be estimated from the parameter values in the $n-1$ equations estimated simultaneously and the aforementioned symmetry restrictions across equations.

Estimating parameters by OLS fails to take account of cross-equation disturbance covariation. It is likely that the disturbance in one regression equation is correlated whith the disturbance in the other equations. Specifically, the disturbance in the labor cost share equation is likely to be correlated with the disturbance in the capital or $R$ cost share equations. The estimated disturbance covariance matrix indicates that there is a high degree of correlation of disturbances between equations.

Most industry studies rely on industry-wide aggregated data. Here we use pooled cross-section and time-series data for 1960-79 from our sample firms in order to reduce the amount of aggregation bias.

## V. *Results*

The parameter estimates of the translog model are presented in Table 4. These estimates are generally quite consistent among the three variations of the basic model. $b_k$ and $b_r$ are positive and statistically significant indicating a positive relationship between capital and the residual input, and output. However, in all three models $b_1$ is significantly negative. These steel firms may have had excess labor probably hired during the expanding world steel market in the 60s and early 70s. Then, as the world market shrank, these steel workers were protected by union contract. $b_t$ is insignificant except in the $YR$ model where it has a large positive value. However, this is offset by a large negative value for $b_{yr}$ in the same model.

TABLE 4

ESTIMATED PARAMETERS
STEEL SAMPLE TRANSLOG PRODUCTION FUNCTION

| | *T* Alone | Add *YR* | Add *CUM* |
|---|---|---|---|
| $b_k$ | 0.376 | 0.726 | 0.373 |
| | (13.03) | (3.99) | (12.52) |
| $b_1$ | − 1.730 | − 1.940 | − 1.740 |
| | (− 18.12) | (− 15.87) | (− 18.27) |
| $b_r$ | 2.354 | 2.214 | 2.367 |
| | (14.43) | (10.55) | (13.60) |
| $b_t$ | 0.066 | 1.430 | 0.039 |
| | (1.40) | (2.32) | (0.88) |
| $b_{yr}$ or *cum* | | 4.240 | 0.154E-03 |
| | | (− 0.08) | (1.57) |
| $g_{kk}$ | 0.053 | 0.050 | 0.054 |
| | (16.24) | (14.62) | (15.54) |
| $g_{11}$ | 0.017 | 0.151 | 0.169 |
| | (20.73) | (14.01) | (20.89) |
| $g_{rr}$ | 0.194 | 0.179 | 0.197 |
| | (16.52) | (11.77) | (20.08) |
| $g_{tt}$ | − 0.004 | 0.660E-03 | 0.188E-02 |
| | (− 1.48) | (0.30) | (0.81) |
| $g_{k1}$ | − 0.013 | − 0.011 | − 0.013 |
| | (− 6.52) | (− 5.03) | (− 6.17) |
| $g_{kr}$ | − 0.040 | − 0.039 | − 0.041 |
| | (− 11.90) | (− 8.51) | (− 14.43) |
| $g_{1r}$ | − 0.154 | − 0.140 | − 0.156 |
| | (− 12.15) | (− 8.58) | (− 12.67) |
| $g_{kt}$ | − 0.001 | − 0.023E-02 | − 0.007E-01 |
| | (− 3.66) | (− 0.29) | (− 0.81) |
| $g_{1t}$ | 0.001 | − 0.004E-01 | 0.147E-02 |
| | (4.19) | (− 0.52) | (2.32) |
| $g_{rt}$ | 1E-04 | 0.064E-02 | − 0.077E-02 |
| | (0.18) | (0.91) | (− 1.45) |
| $g_{yr}$ or *cum* | | 2.170 | − 0.365E-08 |
| | | (0.21) | (− 0.60) |
| $g_{kyr}$ or *kcum* | | − 0.084 | − 0.936E-06 |
| | | (− 2.03) | (− 1.04) |
| $g_{lyr}$ or *lcum* | | 0.092 | 0.102E-06 |
| | | (2.92) | (0.17) |
| $g_{tyr}$ or *tcum* | | − 0.293 | − 0.591E-05 |
| | | (− 2.26) | (− 1.90) |
| $g_{ryr}$ or *rcum* | | − 0.008 | 0.834E-06 |
| | | (− 1.47) | (2.13) |
| log of max likelihood fn. | 475 | 262 | 1015 |

*t*-statistic in parentheses

$g_{kk}$, $g_{11}$, and $g_{rr}$ are acceptably positive and significant in each model. However, the interaction coefficients, $g_{k1}$, $g_{kr}$, and $g_{1r}$, are significantly negative in each model. This may be explained by the complementarity of the inputs. For instance, if the expansion of capital lags the hiring of more labor, the necessary proportion of capital to labor is not maintained, limiting the increase in production.

The coefficient of interaction between labor and the time trend, $g_{1t}$, is significantly positive except in the *YR* model where it is negative and statistically insignificant. This is not strange because the coefficient of interaction between labor and years of experience of the firm, $g_{1yr}$, is significantly positive in the *YR* model. $q_{1yr}$ may well have absorbed the impact of interaction between labor and the time trend.

The elasticity of substitution between capital and labor was found to be $-9.63$ indicating that capital and labor were complements in the steel sample. This complementarity points out a limited flexibility in the utilization of capital and labor. Such rigidity in factor proportion may have allowed technological change to relax this dependency.

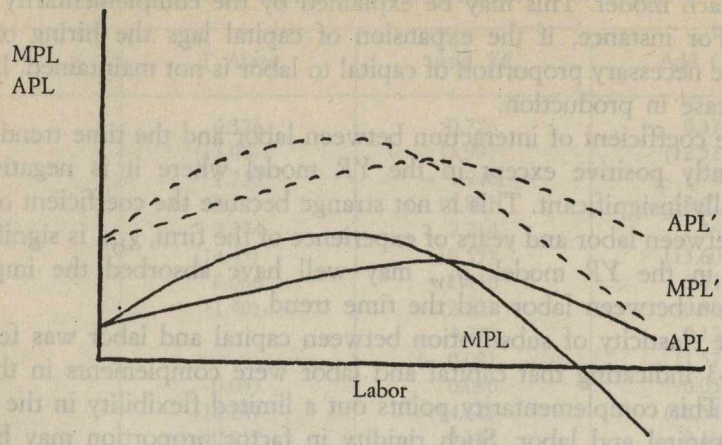
The log of the maximum likelihood function is significantly higher in the *CUM* model than in either the *YR* or the *T* (time trend alone) models. This indicates a better fit to the data when using cumulative output of the sample firms to represent endogenous technological change [2]. Therefore, using the *CUM* model we now assess the role of technological change in boosting labor productivity.

We see in Table 3 that the average product of labor (*APL*) for the sample firms in the period 1972-78 increased from the period 1960-66. However, the marginal product (*MPL*) in both periods was below the *APL* which should result in a decline in the *APL*. Additionally, from 1960 to 1978 there occurred a decline in the capital-labor ratio in our sample (see Table 3). This alone should cause a decline in the *APL* and *MPL*. However, we have seen that the *APL* increased.

Clearly, given the circumstances, the sample firms must have been in region II of production (positive but declining *APL* and *MPL*). Therefore, the increase in the *APL* between 1960-66 and 1972-78 must have been due to technological improvements. This would have resulted in a net upward

[2] The Durbin-Watson statistics for each of the estimating equations are in the inconclusive region indicating that we may not be able to reject the possibility of autocorrelation. However, the inclusion of firm-specific dummy variables removes autocorrelation across firms. This leaves us, across time, with 19 observations per firm which essentially eliminates worthwhile conclusions drawn from the Durbin-Watson statistics (see DRAPER and SMITH, 1981).

FIGURE 1. Average and Marginal Product Curves for Labor




shift in the *APL* and *MPL* curves which would explain our results (see Figure 1).

Next, we can distinguish in the *CUM* model the differential impact on the *MPL* of the exogenous (*T*) and endogenous (*CUM*) experience variables (see Table 5). The derivative of the *MPL* function with respect to *T* (*dMPL/dT*) gives us the impact on the *MPL* of a one year increase in the time trend (exogenously inspired technical change). Thus, during 1960-66, each additional year boosted the *MPL* 0.3 percent compared to reducing the *MPL* 1.9 percent during 1972-78. The derivative of the *MPL* function with respect to *CUM* (*dMPL/dCUM*) gives us the impact on the *MPL* of a one unit increase in cumulative output of the sample firms. Thus, the annual growth in the *MPL* due to endogenously generated technical advances was 3.4 percent in 1960-66 and $-0.5$ percent in 1972-78.

It is possible that the productivity advances were due to increasing returns to scale (*RTS*) and not technological change. Therefore we approximated the *RTS* by estimating a Cobb-Douglas production function (a more restrictive functional form):

$$\ln Q = -2.52 + .255 \ln L + .071 \ln K + .656 \ln R + .003 \ln T + \\ + 0.27 \ln CUM + .04\, D1 + .046\, D2 + .017\, D3$$

where *D*1, *D*2, and *D*3 are firm-specific dummy variables. The estimated coefficients of the factor inputs represent the elasticity of output with respect to each of the inputs. The sum of the output elasticities gives us the *RTS* of 0.98 indicating possible diminishing *RTS*. The resulting *t*-statistic

TABLE 5

LABOR PRODUCTIVITY AND IMPACT OF TECHNOLOGICAL CHANGE IN STEEL SAMPLE USING *CUM* OR *YR*

| | USING *CUM* | |
|---|---|---|
| | 1960-66 | 1972-78 |
| *APL* | 0.16E-04 | 0.20E-04 |
| *MPL* | 0.34E-05 | 0.42E-05 |
| *dMPL/dT* | 0.10E-07 | − 0.81E-07 |
| *dMPL/dCUM* | 0.02E-08 | − 0.02E-09 |
| | USING YR | |
| *MPL* | 0.03E-04 | 0.04E-04 |
| *dMPL/dT* | 4.33E-07 | 4.36E-07 |
| *dMPL/dYR* | 91.00E-07 | 41.70E-07 |

*APL* (average product of labor) is the ratio of the average output (in 000,000,000 tons) of the sample firms to the average number of production manhours in the sample.

*MPL* (marginal product of labor) = $(d\ln Q/d\ln L)\,(Q/L)$; *MPL* is the derivative of the estimated translog production function with respect to $\ln L$ multiplied by the *APL*. $\ln q$, $\ln L$, and $\ln K$ are annual averages for the four-firm sample.

*dMPL/dT* is the derivative of the *MPL* function with respect to $T$ (time trend), i.e. the impact on *MPL* of a one-year increment in the time trend:

$$1/L\,(dQ/dT\,(b_1 + g_{k1}\ln K + g_{r1}\ln R + g_{11}\ln L + g_{1t}T + g_{cum}CUM) + g_{1t}Q)$$

*dMPL/dCUM* is the derivative of the *MPL* function with respect to *CUM*, i.e. the impact on *MPL* of a one unit increase in cumulative output:

$$1/L\,(dQ/dCUM\,(b_1 + g_{k1}\ln K + g_{r1}\ln R + g_{11}\ln L + g_{1t}T + g_{1cum}CUM) + g_{1cum}Q)$$

*dMPL/dYR* is the derivative of the *MPL* function with respect to a one unit increase in the natural log of the cumulative years of experience of the sample firms:

$$1/L\,(dQ/dYR\,(b_1 + g_{k1}\ln K + g_{r1}\ln R + g_{11}\ln L + g_{1t}T + g_{1yr}YR) + g_{1yr}Q)$$

for *RTS* is − 0.53 signifying we cannot reject the null hypothesis of constant *RTS*.

Also we tested for the bias of technical change. If $g_{it}$, $g_{icum}$, or $g_{iyr}$ is positive (negative), then technical change is said to be factor-using (saving). Factor-using technical progress implies increases in the cost share of the factor over time, and vice versa. Whichever learning variable we include (*CUM* or *YR*) the bias of endogenous technical change is capital-saving and

labor-using, confirming Wills' findings. Exogenous technical change, represented by $T$, has a similar bias.

## VI. *Conclusions*

First, we have found that we can distinguish between endogenous and exogenous sources of technological change. Second, the use of *CUM* enhances the fit of our model. Third, endogenous learning by doing, represented by cumulative output (*CUM*), does play a role in advancing productivity, whereas exogenous factors generally have a negative impact. The positive influence of both sources of technological change, however, has diminished in the steel industry sample. Fourth, technological change has had a distinct capital services-saving bias.

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## CAMBIAMENTO TECNOLOGICO E SUO IMPATTO SULLA PRODUTTIVITÀ: L'INDUSTRIA SIDERURGICA STATUNITENSE

In questo articolo viene esaminato l'impatto del cambiamento tecnologico sulla produttività nell'industria siderurgica statunitense. Questa espressione della potenza industriale degli Stati Uniti, è da quasi un decennio assediata dalla concorrenza estera. Mentre il ruolo del cambiamento tecnologico nella crescita della produttività è generalmente significativo, le sue origini sono difficili da individuare. Il cambiamento tecnologico può originare da esperienze proprie di un'impresa, (endogeno), o da sviluppi esterni all'impresa e al suo processo produttivo (esogeno). La fonte endogena del progresso tecnico, chiamata « learning by doing » ha suscitato ricerche relative al suo impatto sulla produttività e alle possibilità di stimolare il « learning ».

Precedenti studi sull'industria dell'acciaio hanno utilizzato dati dell'industria siderurgica in generale e/o hanno trascurato di verificare il ruolo del cambiamento

tecnologico. In questo articolo viene usato un campione di quattro imprese appartenenti all'industria siderurgica statunitense per stimare una funzione translog di produzione che include variabili che rappresentano cambiamenti tecnici esogeni ed endogeni. Risulta che negli Stati Uniti il cambiamento tecnologico nel periodo 1960-78 è stato principalmente endogeno.

# RISULTATI DI BILANCIO 1987
# 98° ESERCIZIO

Domenica 10 aprile, l'Assemblea dei Soci, riunita in prima convocazione, presso i locali della Banca, in Ragusa via Archimede, ha approvato, all'unanimità, il Bilancio dell'esercizio 1987, di cui si riportano i dati più significativi:

| | |
|---|---|
| Raccolta da clientela | **1.054** miliardi (+ 13,21%) |
| Raccolta indiretta | **183** miliardi (+ 45,23%) |
| Impieghi | **329** miliardi (+ 16,30%) |
| Utile netto | **8** miliardi (+ 17,11%) |
| Patrimonio | **150** miliardi (+ 13,19%) |

Sono stati, inoltre, ricostituiti gli organi sociali che risultano così composti:
**Consiglio di Amministrazione:**
Presidente: cav. di Gr. Cr. Dott. Giambattista Cartia - Vice Presidente: Dott. Mario Schininà
Consiglieri: Dott. Giovanni Arezzo, Comm. Avv. Giuseppe Cannizzaro, Rag. Emanuele Criscione, Dott. Giovanni Demostene, Rag. Salvatore Digrandi, Comm. Geom. Nunzio Gaurdiano, Avv. Angelo Micieli, Dott. Giorgio Polara, Rag. Salvatore Scarso.
**Collegio Sindacale:**
Presidente: Dott. Giorgio Bonomo
Sindaci effettivi: Sig. Armando Nicita, Dott. Rosario Ottaviano
Sindaci supplenti: Rag. Antonino Paolino, Dott. Lorenzo Pinzero.
**Collegio dei Probiviri:**
Dott. Vito Curiale, Avv. Giuseppe di Paola, Dott. Giovanni Giampiccolo.

Il dividendo, L. 1.150 per azione - incremento 15% rispetto al passato esercizio - è in pagamento presso le dipendenze della Banca dall'11 aprile 1988.

*Banca Agricola Popolare di Ragusa*

*28 filiali in Sicilia*

Sede Sociale e Direzione Centrale - RAGUSA - Via G. Matteotti, 84

# Assemblea dei Soci

**L'assemblea dei Soci della Banca Popolare di Milano, riunita il 30 aprile 1988 sotto la presidenza del prof. avv. Piero Schlesinger, ha approvato il bilancio al 31 dicembre 1987 e la proposta di ripartizione dell'utile d'esercizio.**

| PRINCIPALI EVIDENZE CONTABILI AL 31 DICEMBRE 1987 | |
|---|---|
| **Raccolta da clientela** | **L. 9.002 miliardi (+ 4,8%)** |
| **Massa fiduciaria** | **L. 15.248 miliardi (+ 7,9%)** |
| **Raccolta indiretta** | **L. 7.339 miliardi (+ 15,7%)** |
| **Impieghi per cassa** | **L. 5.533 miliardi (+ 7,8%)** |
| **Crediti di firma** | **L. 1.485 miliardi (+ 27,3%)** |

Nella seconda metà del 1987 sono state poste le premesse per un ulteriore, significativo potenziamento della presenza della Banca e del Gruppo di cui è capofila nel parabancario, attraverso la costituzione di nuove società controllate, una della quali (Bipiemme - Gestione Polizze di Assicurazione) è già operante.

L'esercizio si è chiuso con un risultato economico, dopo le imposte, di L. 130,8 miliardi, destinati per L. 8 miliardi al Fondo di riserva ordinaria, per L. 41 miliardi al Fondo di riserva disponibile e per L. 81,8 miliardi alla ripartizione ai Soci (L. 78,4 miliardi nel 1986) con assegnazione di un dividendo di L. 525 per azione, invariato rispetto al 1986.

Nel corso della stessa assemblea è stato approvato anche il bilancio dell'incorporata Banca Popolare di Bologna e Ferrara, ai cui ex-azionisti verrà parimenti pagato il dividendo di L. 525 per azione per tutte le n. 12,9 milioni di azioni di nuova emissione attribuite loro in sede di concambio. Il dividendo è stato reso pagabile dal 2 maggio presso tutti gli sportelli della Banca.

A seguito dell'incorporazione, le poste contabili della Banca Popolare di Milano evidenziavano all'1.1.88 una massa fiduciaria di L. 16.082 miliardi, impieghi per cassa per L. 5.904 miliardi, un patrimonio di L. 986,9 miliardi e fondi rischi su crediti per L. 333,5 miliardi.

L'assemblea ha altresì preso atto che l'Organizzazione territoriale delle aziende bancarie del Gruppo Bipiemme (capofila Banca Popolare di Milano, controllate Banca Agricola Milanese e Banca Briantea) si articolava all'1.1.88 su 225 sportelli, dislocati in 14 province (raccolta complessiva da clientela L. 11.277 miliardi, impieghi per cassa a favore della clientela L. 6.782 miliardi).

## CARICHE SOCIALI

Le cariche sociali per l'esercizio 1988 risultano così attribuite:

**Consiglio di Amministrazione**
Schlesinger prof. avv. Piero *(presidente)*; Marchetti prof. dott. Piergaetano, Martelli prof. dott. Antonio *(vice presidenti)*; Arcadu avv. Giuseppe, Arduini prof. dott. Remo, Baglioni prof. dott. Guido, Basadonna rag. Luciano, Beato dott. Francesco Paolo, Cerini dott. Elio, Corradino Ruggero, Cutrera avv. Achille, De Marco prof. ing. Marco, Falsitta prof. dott. Gaspare, Fantoni Giorgio, Martelli dott. Paolo, Mottura prof. dott. Paolo *(consiglieri)*.

**Collegio Sindacale**
Brizzi dott. Michele *(presidente)*; Naggi dott. Giancamillo, Nicolini dott. Enrico *(sindaci effettivi)*; Castoldi dott. Mario, Romano dott. Fabio *(sindaci supplenti)*.

**Direttore Generale**
Aldo Cova.

# BANCA POPOLARE DI VERONA

Il 23 aprile si è tenuta l'Assemblea dei soci della Banca Popolare di Verona, che ha approvato la Relazione del Consiglio di amministrazione e il Bilancio dell'

## ESERCIZIO 1987

I mezzi amministrati si sono evidenziati in **4.991** miliardi, di cui **3.441** rappresentano la raccolta dai clienti.

Gli impieghi diretti sull'economia hanno raggiunto **2.076** miliardi, con un aumento di **190** miliardi rispetto all'anno precedente: quelli a medio termine, posti in essere con il tramite degli Istituti di categoria delle Banche Popolari, ammontano a **359** miliardi. Le risorse finanziarie impiegate dalla Banca direttamente o indirettamente nell'economia hanno quindi superato **2.385** miliardi; i crediti di firma **210** miliardi.

Il portafoglio titoli di proprietà ammonta a **1.462** miliardi.

La consistenza del patrimonio: capitale sociale, riserve e fondi assimilati ammonta a **894** miliardi.

Il bilancio infine ha fatto risultare un utile da ripartire di L. **40.563.822.948** e il dividendo è stato deliberato nella misura di L. **1.500** per azione di nominali L. 500.

---

**Consiglio di amministrazione:** Presidente Giorgio Zanotto; Vice Presidenti Giacomo Galtarossa e Francesco Pasti; Consiglieri: Alberto Bauli, Giovanni Pietro Biasi, Ugo Della Bella, Enzo Erminero, Giuseppe Fedrigoni, Mario Fertonani, Leonardo Gemma Brenzoni, Giuseppe Nicolò, Ferdinando Peloso, Pietro Perissinotto, Luigi Andrea Poggi, Antonio Polin, Giuseppe Randi, Carlo Rizzardi.

**Collegio sindacale:** Presidente Giuseppe Bruni; Sindaci effettivi: Giovanni Benciolini, Giorgio Maria Cambié, Guido Ottaviani, Luigi Valotto; Sindaci supplenti: Giuseppe Parolini, Giovanni Tantini.

**Collegio dei probiviri:** Effettivi: Renato Gozzi, Carlo Vanzetti, Aldo Zenari; Supplenti: Marco Cicogna, Leopoldo Conforti.

**Direttore Generale:** Gianfranco Del Nero, **Vice Direttore Generale:** Elio Bragantini.

# BANCA POPOLARE SICILIANA

## ASSEMBLEA ORDINARIA DEI SOCI

Domenica 24 Aprile 1988 ha avuto luogo a Canicattì, presieduta dal Sig. Carlo La Lomia, l'Assemblea Ordinaria dei Soci della Banca Popolare Siciliana che ha approvato il Bilancio ed il Conto Economico dell'esercizio 1987.

La relazione del Consiglio di Amministrazione ha illustrato i positivi risultati di gestione e la costante crescita dell'Istituto messa in evidenza dalle seguenti più significative voci di bilancio:

| | (in miliardi di lire) | |
|---|---|---|
| **Totale raccolta** | **866,8** | (+16,07%) |
| **di cui Diretta** (depositi e C/C) | **787,9** | (+ 6,24%) |
| **Mezzi amministrati** | **947,4** | (+ 7,36%) |
| **Impieghi con Clientela** | **278,9** | (+ 9,18%) |
| **Mezzi propri** | **59** | (+ 2,22%) |
| **Utile netto** | **3,8** | (+16,01%) |

La proposta della ripartizione dell'utile netto di £.3.814.170.146 è stata approvata con l'assegnazione del dividendo di £.1.100 per azione che i soci possono ritirare, previa presentazione dei certificati azionari, presso qualsiasi sportello della Banca Popolare Siciliana.

### CARICHE SOCIALI

**Consiglio di Amministrazione:**

Sig. Carlo LA LOMIA (*Presidente*)
Prof. Francesco FARACI (*nuovo eletto*)
Prof. Carmelo Gallo
Dr. Giuseppe SILLITTI (*nuovo eletto*)
Dr. Gaetano TROPIA
Dr. Nicolò ADAMO (*V. Presidente*)
Rag. Vincenzo FAVATA
Avv. Giuseppe SIGNORINO
Prof. Carlo SORCI (*nuovo eletto*)

**Collegio Sindacale:**

Dr. Pietro FAZIO (*Presidente*)
Prof. Diego CALLARI
Rag. Stefano NICOSIA (*supplente*)
Prof. Aurelio CANDIANO
Dr. Giuseppe LO VERME (*supplente*)

**Direttore Generale:**

Rag. Antonio TEDESCO

BANCA POPOLARE SICILIANA
Società Cooperativa a r.l. /Sede Sociale e Direzione Generale: CANICATTÌ
PATRIMONIO SOCIALE AL 24-4-1988 / L. 59.063.270.645
Aderente al Fondo Interbancario di Tutela dei Depositi

# BANCA POPOLARE VICENTINA

Società Cooperativa a responsabilità limitata - Sede legale: Vicenza - Via Btg. Framarin, 18
Iscritta presso il Tribunale di Vicenza al nr. 2 Soc. - Aderente al Fondo Interbancario di Tutela dei Depositi
Codice fiscale 00204010243
Capitale sociale e riserve al 31.12.1987: Capitale sociale versato L. 4.379.153.500 - Riserve L. 263.165.045.718

## Assemblea ordinaria dei Soci

L'Assemblea dei Soci della Banca Popolare Vicentina svoltasi il 23 aprile 1988 sotto la presidenza del dott. Giuseppe Nardini ha approvato il bilancio al 31 dicembre 1987 e la proposta di riparto dell'utile dell'esercizio.
Dopo ammortamenti per lire 9.232 milioni, e accantonamenti diversi per lire 24.320 milioni l'utile da ripartire dopo le imposte (lire 15.500 milioni) è risultato di lire 14.681 milioni e ha consentito di fissare un dividendo di lire 1.650 per azione.
Il 1987 è stato caratterizzato dall'ampliamento della sfera operativa; oltre ad aver aperto la nuova filiale di Castelfranco Veneto e aver quasi completato l'allestimento di quella – pure nuova – di Padova, la Banca Popolare Vicentina ha maturato la possibilità attraverso le nuove disposizioni della Banca d'Italia in materia di sportelli di aprire altre 7 nuove dipendenze a piena operatività nell'ambito dell'area di mobilità che comprende le regioni Veneto e Friuli Venezia Giulia e le province di Brescia, Mantova, Bolzano, Trento e Ferrara.
Sull'estero maggiori possibilità di lavoro sono derivate dalla apertura dell'Ufficio di Rappresentanza di Hong Kong che si aggiunge a quello di Londra e di Uffici di mandato a Mosca e Nuova Delhi oltre a quello già esistente di New York.
Il 1987 è anche stato un anno di cospicui investimenti, in relazione sia ai nuovi insediamenti che al potenziamento ed affinamento dell'apparato informatico centrale e periferico.
Nel corso della stessa Assemblea è stato approvato anche il bilancio dell'incorporata Banca Popolare di Thiene ai cui ex azionisti verrà pagato un dividendo di lire 2.000 per azione.
A seguito dell'incorporazione, le voci contabili della Banca Popolare Vicentina evidenziano le seguenti cifre:

| | |
|---|---|
| Raccolta da clienti | L. 1.785 miliardi |
| Impieghi | L. 951 miliardi |
| Titoli di proprietà | L. 694 miliardi |
| Patrimonio sociale | L. 267 miliardi |
| Raccolta indiretta | L. 1.750 miliardi |
| Utile da ripartire | L. 16 miliardi |

**Cariche sociali**
Le cariche sociali per l'esercizio 1988 sono così attribuite:
**Consiglio di Amministrazione:** Giuseppe Nardini Presidente, Giovanni Bettanin, Giovanni Maria Brazzale e Giancarlo Ferretto Vice Presidenti, Luigi Turato Consigliere Segretario, Marino Breganze, Umberto Frigo, Giorgio Macerata, Attilio Maraschin, Gianfranco Rigon, Giovanni Stefani, Pierluigi Tapparo, Giorgio Tibaldo, Glauco Zaniolo, Marcello Zanon, Franco Ziche e Giovanni Zonin Consiglieri.
**Collegio Sindacale:** Giuseppe Rebecca Presidente, Giacomo Cavalieri, Piergiorgio Dalla Massara, Giovanni Zamberlan e Antonio Zanarotti Sindaci effettivi, Domenico Silvio Fracasso e Gianfranco Simonetto Sindaci supplenti.
**Comitato degli Arbitri:** Anacleto Lucangeli Presidente, Libero Giuriolo e Giorgio Oliva Arbitri effettivi, Gian Giacomo di Thiene e Carlo Giacobbo Arbitri supplenti.
**Direttore Generale:** Carlo Pavesi.

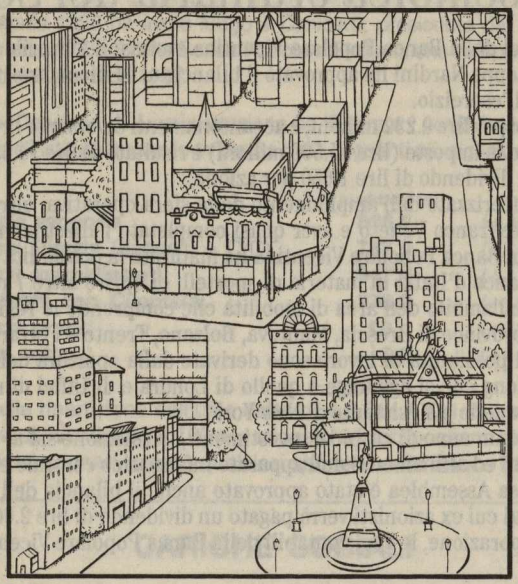
# BILANCIO 1987 DEL CREDITO FONDIARIO SPA E DELLA SEZIONE AUTONOMA OPERE PUBBLICHE.

| BILANCIO | (in miliardi di lire) |
|---|---|
| Mezzi di terzi amministrati | 4.051,7 |
| Patrimonio netto e fondi rischi | 646,3 |
| Impieghi in mutui e anticipazioni | 3.896,5 |
| Utile di esercizio | 52,5 |

Si è tenuta a Roma giovedì 28 aprile, l'Assemblea ordinaria degli Azionisti del Credito Fondiario S.p.A., che ha approvato i bilanci dell'Istituto e della Sezione Opere Pubbliche chiusi al 31 dicembre 1987. Il Presidente in apertura ha ricordato che l'esercizio conclusosi è stato il 90° della

**1898/1988**

vita della Società che si è appunto costituita il 28 aprile 1898 ed il Consiglio di amministrazione ha sottolineato nella sua relazione come le posizioni raggiunte testimonino il grande lavoro svolto in tutti questi anni di attività e costituiscano motivo di soddisfazione e di stimolo per traguardi sempre più ambiziosi anche nella prospettiva di una integrazione europea ormai imminente.



Per lo scorso esercizio i risultati conseguiti evidenziano una ragguardevole espansione operativa dell'Istituto. Nell'87 sono stati erogati finanziamenti di credito fondiario ed edilizio e alle opere pubbliche per un importo pari a 860,5 miliardi, con un incremento del 44% rispetto all'86. Pertanto la consistenza degli impieghi in essere a fine anno del Credito Fondiario S.p.A. e della Sezione Opere Pubbliche è salita a 3.896,5 miliardi. Nello stesso periodo le domande di credito fondiario ed edilizio pervenute all'Istituto sono state pari a 1.890,3 miliardi, il 41,1% in più rispetto all'anno precedente.

Con riferimento all'aspetto reddituale, dedotti 33,6 miliardi di accantonamenti ai fondi rischi e 37,5 miliardi a fronte di imposte sul reddito, l'utile netto consolidato è stato pari a 52,5 miliardi. Dopo aver accantonato a riserve patrimoniali 39 miliardi l'Assemblea ha deliberato di corrispondere un dividendo di 180 lire per azione (pari al 18% del valore nominale). Esso, tenendo presente l'aumento gratuito di capitale ultimamente intervenuto, è superiore del 20% a quello distribuito lo scorso anno.

I fondi propri dell'Istituto e della Sezione sono passati dai 583,5 miliardi di inizio '87 agli attuali 646,3 miliardi.

Il dividendo è pagabile a partire dal 17 maggio 1988 su presentazione dei certificati azionari ai sensi delle disposizioni di legge, presso le Casse incaricate: Banca Commerciale Italiana, Banco di Roma, Credito Italiano, Banco di Santo Spirito, Banca Nazionale dell'Agricoltura, Banca Nazionale del Lavoro, Banca Popolare di Milano, Banca Popolare di Novara, Nuovo Banco Ambrosiano, Banco di Napoli, Banco di Sardegna, Banco di Sicilia, Cassa di Risparmio delle Provincie Lombarde, Istituto Bancario Italiano, Istituto Bancario San Paolo di Torino, Monte dei Paschi di Siena, CreditWest, Monte Titoli S.p.A. (per i titoli dalla stessa amministrati) e presso la Sede Sociale.

Con la nomina di due nuovi Amministratori gli organi sociali risultano così composti: Consiglio di amministrazione: Presidente: Dott. Mario Piovano; Vice Presidente: Dott. Oliviero Prunas; Consiglieri: Dott. Attilio Aquila, Dott. Massimo Bacci, Dott. Aldo Buoncristiano, Dott. Gaetano Cigala Fulgosi, Dott. Orazio Flacchi, Sig. Antonio Masala, Dott. Francesco Picardi, Dott. Giacomo Salvemini, Dott. Ugo Tabanelli. Segretario: Dott. Antonello Delcroix. Collegio sindacale: Presidente: Dott. Carlo Garramone; Sindaci effettivi: Sig. Carlo Griffa, Dott. Walter Pirani; Sindaci supplenti: Avv. Massimo Oliva, Dott. Gianfranco Mancuso. Direttore Generale è l'Avv. Filippo Nazzaro.

La Banca Commerciale Italiana, il Credito Italiano e il Banco di Roma partecipano al capitale sociale e rappresentano l'Istituto a mezzo delle loro Dipendenze.

Sede in Roma: 00147 via Cristoforo Colombo 80
Uffici: 00154 Circonvallazione Ostiense 375
Tel. 57961 · Telex 611351 FONSPA I · Telefax 5782251
Capitale sociale e fondi patrimoniali: L. 646.270.356.382

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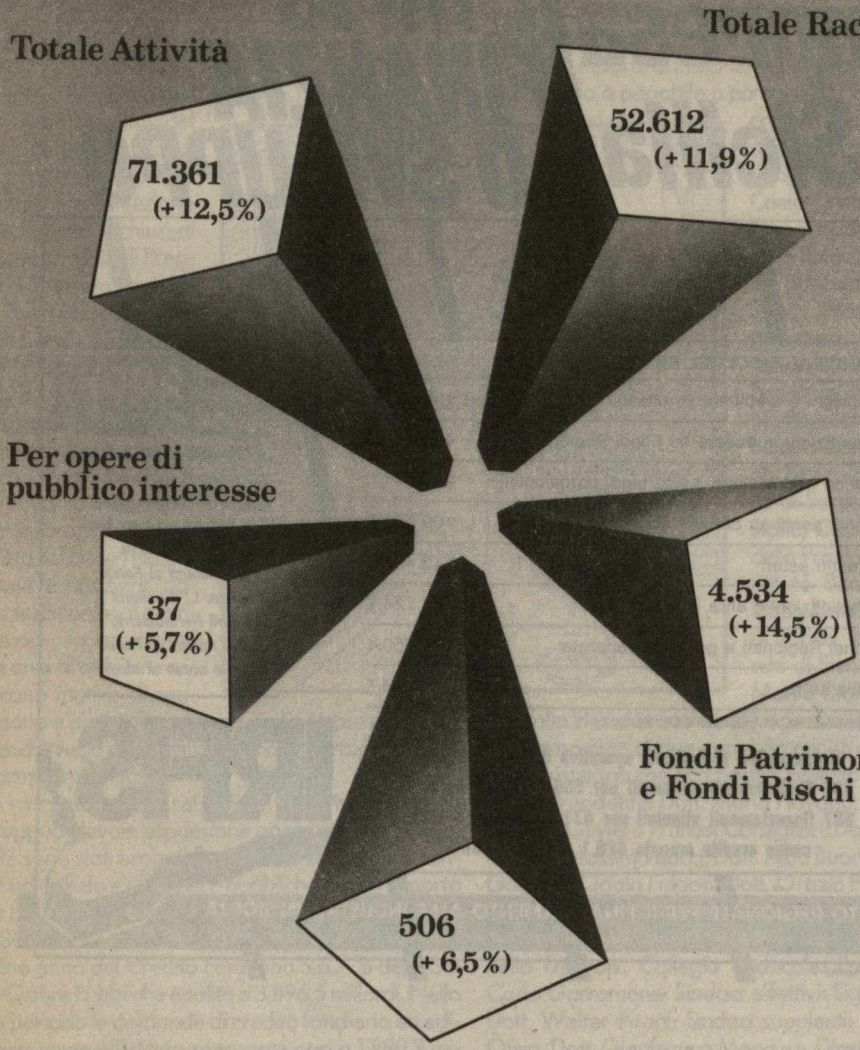
**FONSPA** **CREDITO FONDIARIO**
SOCIETA' PER AZIONI
E SEZIONE AUTONOMA OPERE PUBBLICHE

# BILANCIO 1987

in miliardi di lire




SANPAOLO

ISTITUTO BANCARIO
SAN PAOLO DI TORINO

# ISTITUTO CENTRALE DELLE BANCHE POPOLARI ITALIANE

**SOCIETÀ PER AZIONI**

**CAPITALE SOCIALE E RISERVE AL 31 DICEMBRE 1987: L. 166.401.065.825**

**Direzione Generale: MILANO - Corso Europa, 18**

**Ufficio di Roma e Sede Sociale: ROMA - Via Donizetti, 12/a - 14**

Tribunale di Roma: Registro società n. 526/41 - Fascicolo 598/41

## BILANCIO 1987 (lire miliardi)

| ATTIVO | | PASSIVO | |
|---|---|---|---|
| Corrispondenti debitori e fondi presso l'Istituto di Emissione | 4.154,9 | Corrispondenti creditori e assegni circolari | 4.743,6 |
| Titoli di proprietà | 653,8 | Fondi rischi, assistenza e accantonamenti | 49,2 |
| Partecipazioni | 42,8 | Ammortamenti | 10,2 |
| Crediti verso l'Erario | 57,9 | Partite varie | 29,6 |
| Immobili | 33,9 | Capitale sociale e riserve | 166,4 |
| Altre partite | 61,0 | Utile netto | 5,3 |
| | 5.004,3 | | 5.004,3 |
| Conti impegni, rischi e d'ordine | 44.639,7 | Conti impegni, rischi e d'ordine | 44.639,7 |
| | 49.644,0 | | 49.644,0 |

Il 30 aprile 1988 ha avuto luogo in Roma, presso la sede sociale dell'Istituto, l'assemblea ordinaria degli Organismi associati (Banche Popolari ed Istituzioni della Categoria) che ha approvato il bilancio dell'esercizio 1987.

Dopo l'assegnazione di L. 20 miliardi alla « Riserva disponibile », è stata deliberata la seguente ripartizione dell'utile netto di L. 5.326.820.124:
– distribuzione di un dividendo del 25% alle n. 8.287.060 azioni costituenti il capitale sociale;
– attribuzione alla « Riserva legale » di L. 3,5 miliardi, per aumentarla a L. 21 miliardi;
– ulteriori assegnazioni, ivi compresa la consueta destinazione di una quota ad incremento del « Fondo assistenza Banche Popolari ».

Gli organi sociali dell'Istpopolbanche, dopo le nomine deliberate il 30 aprile 1988, risultano così composti:

CONSIGLIO DI AMMINISTRAZIONE

Presidente: Comm. Dott. Corrado DANIELI; Vice Presidenti: Comm. Rag. Giovanbattista FIORENTINI - Gr. Uff. Avv. Arturo SCHENA; Consiglieri: Gr. Uff. Dott. Rag. Vittorio AULENTI - Comm. Geom. Luigi BACCI - Cav. del Lav. Gr. Uff. Dott. Giancarlo BELLEMO - Gr. Uff. Dott. Rag. Franco CARNIGLIA - On. Cav. di Gr. Cr. Prof. Avv. Francesco COLITTO - Gr. Uff. Rag. Gianfrancesco DEL NERO - Comm. Dott. Elio FARALLI - Comm. Dott. Josef FROSCHMAYR - Comm. Dott. Rag. Andrea GIBELLINI - Cav. Uff. Dott. Mario GIGLIO - Marchese Dott. Franco LUCIFERO - Comm. Dott. Angelo MAZZA - Gr. Uff. Rag. Guido MONZANI - Gr. Uff. Dott. Vincenzo MOSCA - Dott. Giuseppe NARDINI - Comm. Pietro NIADA - Dott. Piermaria PACCHIONI - Comm. Rag. Luciano PASTORELLO - Cav. di Gr. Cr. Dott. Giuseppe PEDRONI - Comm. Dott. Renato SANTARELLI - Cav. di Gr. Cr. Prof. Avv. Piero SCHLESINGER - Cav. Rag. Antonio TEDESCO - Cav. del Lav. Gr. Cr. Rag. Lino VENINI - Comm. Dott. Giuseppe VIGORELLI. Segretario del Consiglio: Dott. Franco DE MAJO.

COLLEGIO SINDACALE

Presidente: Comm. Rag. Ottavio FONTANESI; Sindaci effettivi: Comm. Rag. Pietro AGNOLUZZI - Dott. Domenico MONTOSCHI - Rag. Adriano MORA - Cav. del Lav. Dott. Matteo PITANZA; Sindaci supplenti: Cav. Dott. Antonio DANESE - Cav. Uff. Rag. Giuliano EMPIRONI.

DIREZIONE GENERALE

Direttore Generale: Dott. Franco DE MAJO; Vice Direttore Generale: Dott. Antonio CITARELLA.

# Istituto Italiano di Credito Fondiario

## e Sezione Opere Pubbliche

SOCIETÀ PER AZIONI - SEDE IN ROMA - VIA PIACENZA, 6
CAPITALE SOCIALE L. 108.000.000.000 INTERAMENTE VERSATO
RISERVE E FONDI VARI L. 410.003.791.910
TRIBUNALE DI ROMA - REGISTRO SOCIETÀ N. 219-220/1908

Il 26 aprile 1988, si è svolta l'assemblea ordinaria degli Azionisti.
L'assemblea ha approvato il bilancio al 31 dicembre 1987, la cui regolarità è stata certificata dalla Peat, Marwick, Mitchell S.n.c. Gli impieghi complessivi sono saliti a L. 3.755 miliardi. L'utile di esercizio, dopo ammortamenti e accantonamenti per complessive L. 55,10 miliardi, è risultato di L. 20,09 miliardi che sono stati destinati per L. 7,9 miliardi a riserva ordinaria dell'Istituto e della Sezione OO.PP., per L. 5,7 miliardi a riserva straordinaria dell'Istituto, e per L. 6,48 miliardi agli azionisti, con un dividendo di L. 480 ad azione.

### SINTESI DEL BILANCIO AL 31 DICEMBRE 1987

| ATTIVO | (in milioni) | PASSIVO | (in milioni) |
|---|---|---|---|
| Disponibilità presso Istituti di credito e in cassa | L. 209.873 | Titoli in circolazione | L. 3.850.160 |
| Titoli di proprietà | L. 10.633 | Altre passività | L. 373.060 |
| Finanziamenti | L. 3.755.589 | Fondi rischi su crediti | L. 170.395 |
| Rate maturate | L. 484.390 | Altri fondi | L. 49.107 |
| Altre attività | L. 270.762 | Capitale sociale | L. 108.000 |
| Partecipazioni, immobili, mobili, impianti e macchinari | L. 102.628 | Riserva ordinaria | L. 225.505 |
| | | Riserva straordinaria | L. 37.252 |
| | | Riserva per acquisto azioni sociali | L. 300 |
| | | Utile netto esercizio 1987 | L. 20.096 |
| Totale | L. 4.833.875 | Totale | L. 4.833.875 |

Il dividendo è esigibile dal 17 maggio 1988 presso la sede sociale, ovvero presso la Cassa di Sovvenzioni e Risparmio fra il Personale della Banca d'Italia nelle sedi della Banca stessa in Ancona, Bari, Bologna, Cagliari, Firenze, Genova, Livorno, Milano, Napoli, Palermo, Roma, Torino, Trieste e Venezia, nonché in Milano presso gli uffici delle Direzioni Generali dell'Istituto Centrale di Banche e Banchieri e dell'Istituto Centrale delle Banche Popolari Italiane e, per le azioni amministrate da Montetitoli S.p.A., presso le banche depositarie.

# ISTITUTO per il CREDITO SPORTIVO

**ROMA - Via A. Farnese, 1 - Tel. 06/383451 - Via G. Vico, 5 - Tel. 06/396871**

Il Consiglio di Amministrazione dell'Istituto per il Credito Sportivo si è riunito sotto la presidenza dell'Avv. Renzo Nicolini, per l'approvazione del Bilancio relativo all'anno 1987.

L'esercizio si è chiuso con un utile netto di L. 48,5 miliardi di cui L. 46,3 miliardi sono stati destinati a Riserva Ordinaria.

Il Presidente, nella relazione introduttiva, ha sottolineato il costante incremento dell'attività svolta dall'Istituto nel corso dell'esercizio.

I mezzi patrimoniali dell'Istituto sono passati da L. 391,9 miliardi a L. 502 miliardi con un incremento del 28% per cui la capacità operativa risulta attualmente di L. 25.604 miliardi (+ 32,9%); il tasso applicato attualmente è del 9% che si riduce per il settore degli Enti Locali fino al 6% per effetto della concessione di contributi negli interessi variabile dall'1% al 3% in base all'ammontare del finanziamento ed alla ubicazione dei mutuatari; per i soggetti di natura privatistica la misura del contributo viene raddoppiata per cui il tasso minimo si riduce al 3%.

Nel 1987 sono stati concessi n. 1.047 mutui per un totale di L. 483,9 miliardi (+ 9,4%) e collocate obbligazioni per L. 150 miliardi per cui i titoli I.C.S. in circolazione ammontano a L. 648,4 miliardi (+ 15,8% rispetto al 1987).

**PRINCIPALI DATI DI BILANCIO 1987**

(in miliardi)

| | | |
|---|---|---|
| - Fondi disponibili | L. | 570 |
| - Titoli | L. | 145 |
| - Mutui in gestione | L. | 1.747 |
| - Obbl.ni in circolazione | L. | 648 |
| - Fondo speciale per contributi negli interessi | L. | 222 |

**QUADRO OPERATIVO COMPLESSIVO AL 31 DICEMBRE 1987**

(in miliardi)

| | |
|---|---|
| - Capacità operativa | L. 25.604 |
| - Mutui concessi | L. 2.109 |
| - Richieste in istruttoria | L. 1.208 |

# CRESCONO GLI INVESTIMENTI. CRESCE L'ECONOMIA.

## BILANCIO GENERALE 1987

| | (miliardi di lire) | (percentuale) |
|---|---|---|
| IMPIEGHI ECONOMICI | 6.367 | + 11,10 |
| RACCOLTA DA CLIENTELA | 7.391 | + 6,44 |
| FONDI PATRIMONIALI E DI ACCANTONAMENTO | 967 | + 18,43 |
| UTILE NETTO | 17 | + 5,11 |
| TOTALE DI BILANCIO | 24.616 | |
| NUMERO SPORTELLI | 230 | |

SICILCASSA

CASSA CENTRALE DI RISPARMIO V.E. PER LE PROVINCE SICILIANE

Aderente al fondo interbancario di tutela dei depositi

# BILANCIO 1987

Martedì 26 aprile si è svolta a Trento l'Assemblea ordinaria della Banca di Trento e Bolzano presieduta dall'avv. Dario Vettorazzi.
L'Assemblea, 53ª dalla fondazione, ha approvato le relazioni ed il bilancio presentati dal Consiglio di Amministrazione e dal Collegio Sindacale.

| VALORI DI BILANCIO (in miliardi di lire) | 31.12.87 |
|---|---|
| Massa amministrata | 1398,7 |
| Depositi | 1136,1 |
| Impieghi economici | 746,6 |
| Titoli di proprietà | 462,2 |
| Titoli di Clientela in deposito | 975,5 |
| Utile d'esercizio | 7,2 |
| Patrimonio e fondi diversi | 98,5 |

*I bilanci della Btb sono certificati dalla Arthur Andersen dal 1983.*

Banca di Trento e Bolzano



# STUDI ECONOMICI E SOCIALI

**Rivista di vita economica - Centro Studi « G. Toniolo »**

**Comitato Scientifico:** Mario Arcelli, Gino Barbieri, Michele Cassandro, Siro Lombardini, Giancarlo Mazzocchi, Giovanni Padroni, Giannino Parravicini, Romano Prodi, Franco Reviglio, Sergio Zaninelli.

## SOMMARIO DEL N. 1 - 1988 - ANNO XXIII



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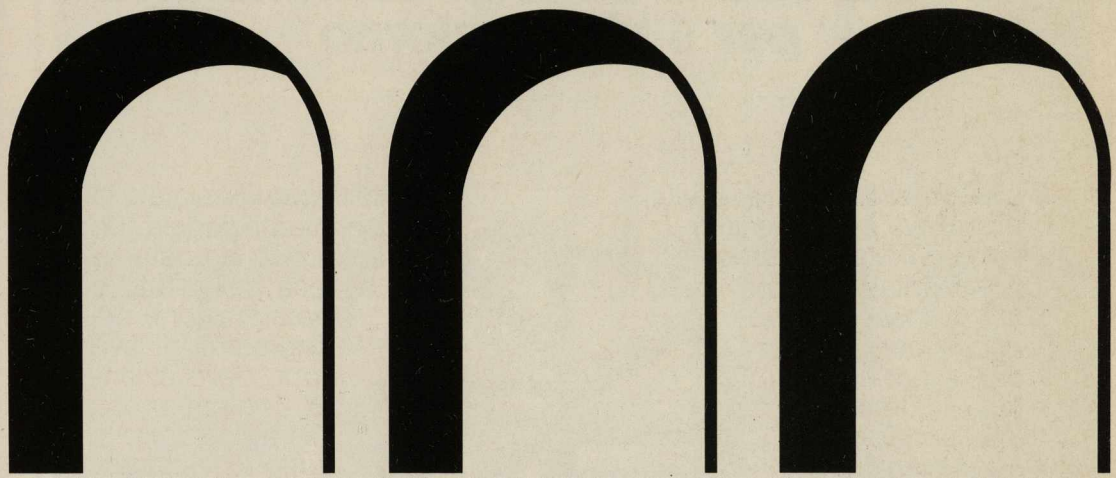
# E' il momento di gettare un ponte.



Lo scenario informatico ha finora offerto per lo più soluzioni vincolate, parziali, insomma chiuse. L'affollarsi di standard privati contrapposti rischia di creare notevoli discontinuità, mentre l'esigenza più viva dell'utente è poter disporre di una via priva di vincoli.

Olivetti è da sempre dalla parte dell'utente. Forte di esperienze determinanti in communication, in processi di automazione e in elaborazione di applicazioni; attentissima nell'utilizzo e nell'integrazione degli standard informatici; impegnata quotidianamente in milioni di uffici, Olivetti conosce a fondo ragioni ed esigenze degli utenti, e ha sviluppato il **PONTE**: una nuova architettura di sistemi che è la risposta più completa e più avanzata che sino ad oggi sia mai stata fornita.

Il Ponte è infatti la struttura con cui si collegano mondi fino a ieri pensati come isolati, è la struttura che porta all'utente tutte quelle caratteristiche che un'architettura di sistemi integrati dovrebbe offrire: il Ponte è una soluzione aperta.

Aperta alla crescita, alla connettività, al progresso tecnologico; è incentrata su standard scelti e sviluppati per la loro funzionalità ed efficacia; consente una continua evoluzione verso il futuro senza rinnegare il passato.

Il Ponte è aperto a tutti: alle piccole, alle medie, alle grandi aziende. Per questo oggi è tempo di aprire i sistemi.

Gettando il Ponte: la Open System Architecture di Olivetti.

## Open System Architecture: la soluzione Olivetti.

La Open System Architecture di Olivetti poggia su LSX 3000, una nuova famiglia di minicomputer a 32 bit articolata su un gran numero di modelli da 2 a 200 utenti; dispone di una vasta gamma di workstation intelligenti specializzate per diverse aree applicative; offre sia il sistema operativo standard basato su UNIX* System V, sia MOS, il consolidato sistema operativo Olivetti; comunica attraverso la serie di prodotti OLINET allineati agli standard ISO/OSI; si integra con ambienti PC MS/DOS** e con l'attuale gamma di minicomputer Olivetti (L1, 3B, CPS); fornisce un ricco catalogo software in grado di soddisfare le esigenze applicative più articolate.

OLIVETTI OPEN SYSTEM ARCHITECTURE

THE BRIDGE

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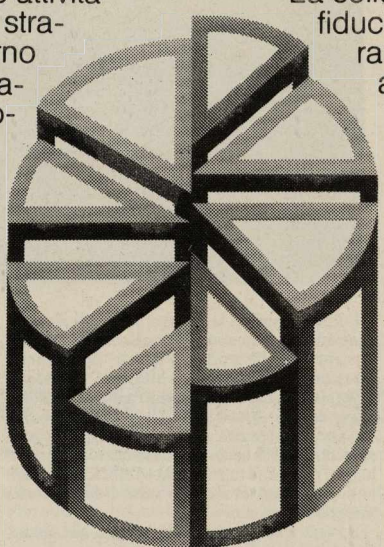

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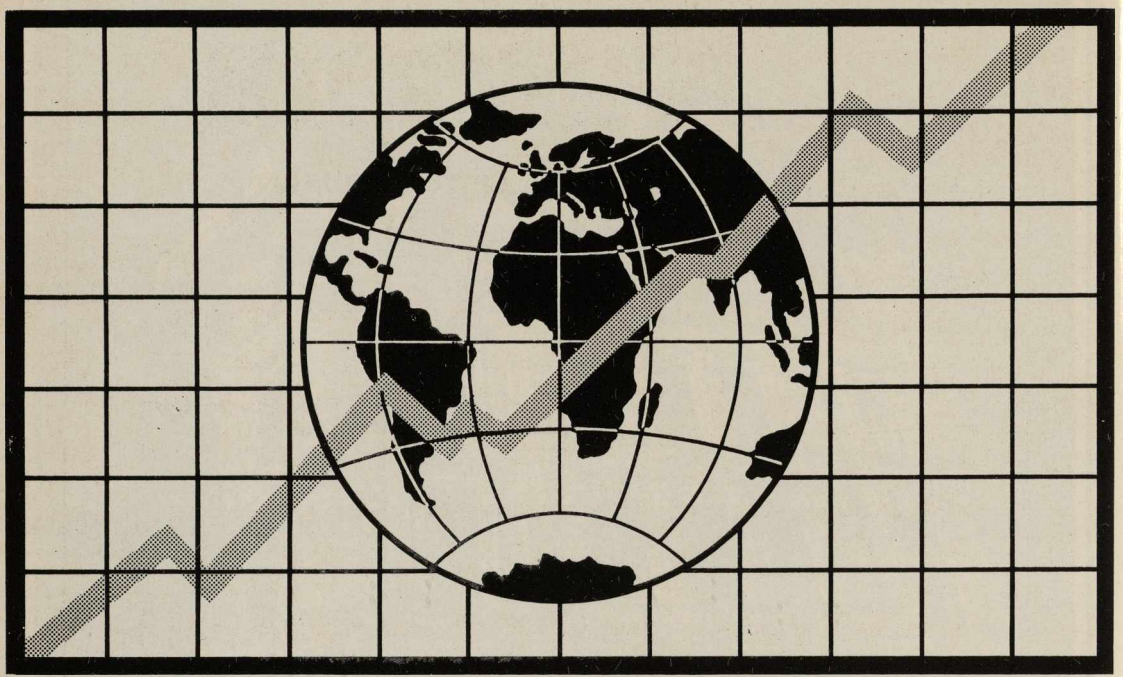
Una Società del Gruppo ASEA BROWN BOVE



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Possiamo offrire tutto questo perchè siamo il Gruppo leader nel settore e facciamo parte del Gruppo BNL Holding Italia, il più importante nel mondo parabancario italiano.

**LOCAFIT**

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**Filiali a:** Biella, Bologna, Brescia, Genova, Milano, Parma, Prato, Torino, Trento, Venezia, Verona e Viareggio.

**gruppo locafit leader nel leasing**

BNL HOLDING ITALIA S.P.A. BNL BNL HOLDING ITALIA S.P.A.


SIP

GRUPPO IRI-STET

## VIDEOTEL SIP: la nuova filosofia del lavoro.

**La differenza tra ricevere dati e lavorare con i dati.**

"Tutto scorre" diceva un filosofo greco. Anche i sistemi di telecomunicazione, che hanno subito una notevole evoluzione per migliorare sempre più la qualità del lavoro. VIDEOTEL è un esempio di questa filosofia. Un televisore opportunamente predisposto o un terminale specializzato ma anche il vostro home o personal computer con un semplice collegamento della linea telefonica al Centro Videotel vi consente di inviare e ricevere dati e informazioni, visualizzati sotto forma di pagine sul vostro monitor. VIDEOTEL non solo fornisce servizi e informazioni in tempo reale, selezionati per argomenti, aggiornati costantemente e disponibili 24 ore su 24, ma vi consente anche di interrogare la vostra banca e compiere tutta una serie di operazioni, chiedere consulenze finanziarie e personalizzate, ricevere e registrare programmi per il vostro computer e richiedere tanti altri servizi e informazioni indispensabili per lavorare meglio ed essere più informati. VIDEOTEL: il nuovo servizio creato dalla SIP per portare i vantaggi dell'informatica anche dove c'è solo un telefono.

ARMANDO TESTA SPA

# La Rete dei Co

# Per darti la ris



**Sempre.**

Il Concessionario IBM assicura la sua costante assistenza pre e post vendita, con dimostrazioni per i diversi e specifici settori di attività e offrendo una consulenza qualificata nella scelta dei programmi e di tutta la gamma di prodotti ausiliari originali IBM.

IBM Concessionario Personal Computer

**Qualità.**

Scegliere un Sistema IBM significa accedere alla qualità dei servizi offerti dalla Rete dei Concessionari: una rete di professionisti formati da IBM per dare ad ogni Cliente un supporto valido e personalizzato.

# ncessionari IBM.

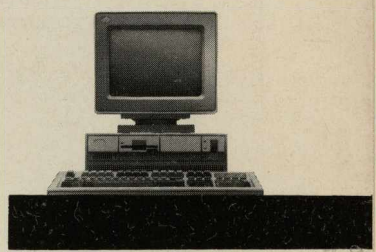
# posta che cerchi.

GGK

**Ovunque.**

La Rete dei Concessionari IBM, presente ovunque sul territorio nazionale e in costante crescita grazie allo sviluppo dei Punti di Vendita Collegati, riesce oggi ad essere sempre vicina alle esigenze di ogni Cliente.

IBM
Punto vendita di Concessionario
Personal Computer



Qualsiasi prodotto IBM rappresenta sempre un vero e proprio punto di riferimento. Non solo per le caratteristiche tecnologiche, costantemente ai più alti livelli. Ma soprattutto per la Rete dei Concessionari IBM, qualificati ad offrire un servizio efficiente e puntuale, dall'assistenza all'addestramento, al supporto pre e post vendita.

Grazie alla loro grande capillarità, i Concessionari IBM e i Rivenditori Autorizzati IBM sono sempre in grado di rispondere alle diverse domande sul mondo PS/2* IBM e sugli altri prodotti IBM, come le Macchine per scrivere, il Microcomputer 6150 o la Serie/1 IBM.

Gli indirizzi sono sulle Pagine Gialle alle voci "Personal Computer" e "Elaboratori Elettronici"; vi accorgerete che per ogni esigenza la soluzione è sempre vicina.

IBM

# GIORNALE DEGLI ECONOMISTI E ANNALI DI ECONOMIA

Anno XLVI (Nuova Serie) Gennaio-Febbraio 1987 N. 1-2

UNIVERSITÀ COMMERCIALE LUIGI BOCCONI
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Ma dalla Lombardia il Credito Commerciale guarda anche all'Europa e al mondo.

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Possiamo farlo con tranquillità perché abbiamo solide radici: siamo nati nel 1907 e non abbiamo mai smesso di crescere.

Cioè di guardare avanti.

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# MALPENSA 2000

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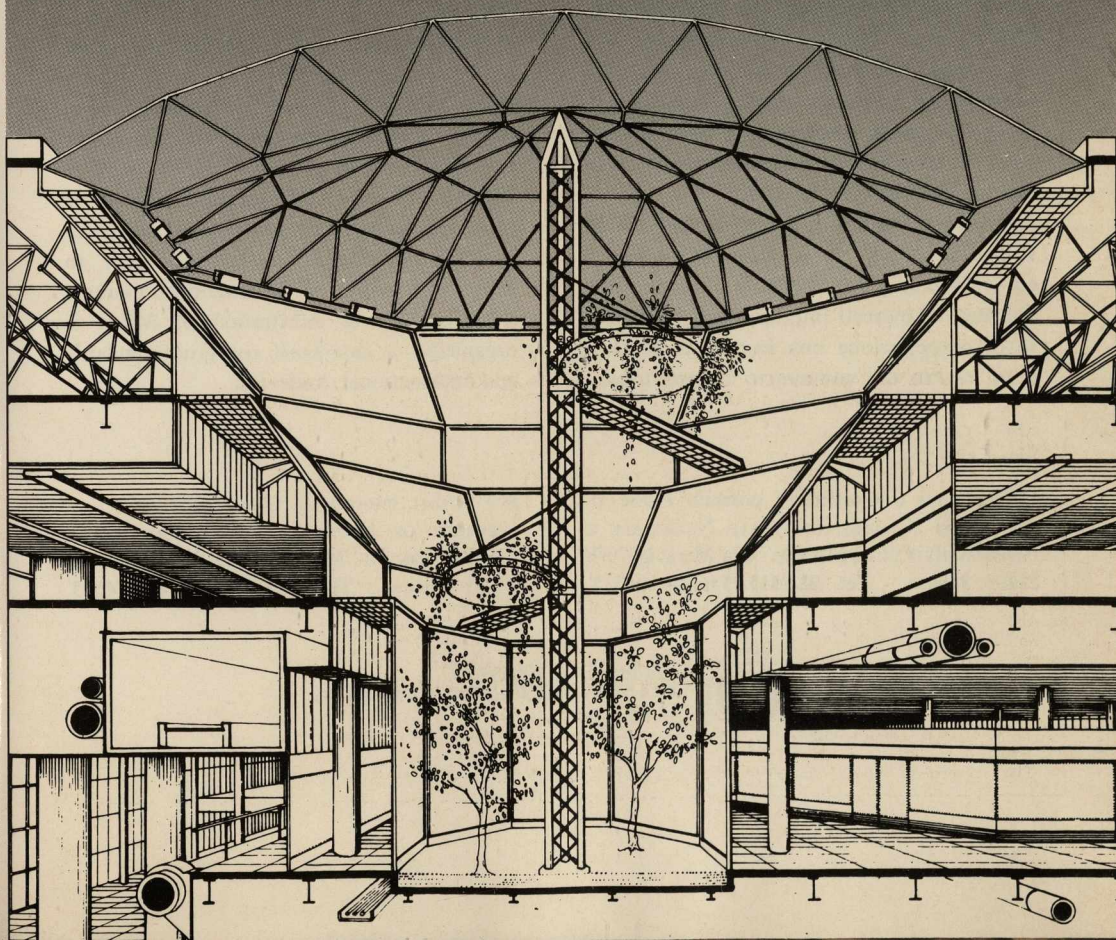
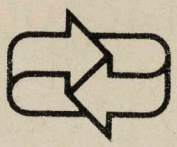
**Società Esercizi Aeroportuali spa**
Aeroporti di
Milano Linate
Milano Malpensa



**Camera Arbitrale Nazionale e Internazionale di Milano**



**Chamber of National and International Arbitration of Milan**

La Camera di Commercio di Milano, nel quadro della sua politica di rinnovamento dei servizi, ha promosso e reso operativa la nuova CAMERA ARBITRALE NAZIONALE E INTERNAZIONALE DI MILANO, costituita in forma di Azienda Speciale della Camera di Commercio, Industria, Artigianato e Agricoltura di Milano.

La CAMERA ARBITRALE è nata per rispondere all'esigenza di creare a Milano una sede adeguata per la composizione extra-giudiziaria di vertenze nazionali ed internazionali. Come è noto, l'arbitrato è lo strumento preferito dagli operatori per la soluzione delle controversie in quanto offre i vantaggi della *rapidità,* della *competenza* e della *riservatezza,* e favorisce il mantenimento di *relazioni* costruttive fra le parti.

La Camera Arbitrale di Milano dispone di strutture e servizi di assoluta *professionalità* ed *efficienza,* e per facilitare l'azione delle imprese sui mercati internazionali ha in corso di progettazione una *banca-dati* sui lodi e sul diritto del commercio internazionale.

The Milan Chamber of Commerce has always pursued a policy to renew all services. For this reason it has promoted and made the new CHAMBER OF NATIONAL AND INTERNATIONAL ARBITRATION OF MILAN fully operating as an External Service of the Milan Chamber of Commerce Industry Handicraft and Agriculture.

The CHAMBER OF ARBITRATION has been created to provide Milan with a suitable seat to settle national and international disputes.

Arbitration has been conceived in order to settle disputes providing some advantages such as *streamlined procedures, competence* and *confidentiality* and to foster *relations* between parties.

The Chamber of Arbitration of Milan is provided with highly *professional* and *qualified* facilities and services. In order to simplify activities on international markets the Chamber of Arbitration of Milan is organizing a *data-bank* concerning awards and international trade law.

Informazioni e *regolamenti* possono essere richiesti alla: CAMERA ARBITRALE NAZIONALE E INTERNAZIONALE DI MILANO - Via Meravigli 9/b 20123 Milano - Tel. 02-8515.4536/4444/4515.

For further information please contact: CHAMBER OF NATIONAL AND INTERNATIONAL ARBITRATION OF MILAN - Via Meravigli 9/b 20123 Milano - Tel. 02-8515.4536/4444/4515.

CAMERA DI COMMERCIO
INDUSTRIA ARTIGIANATO E AGRICOLTURA
DI MILANO